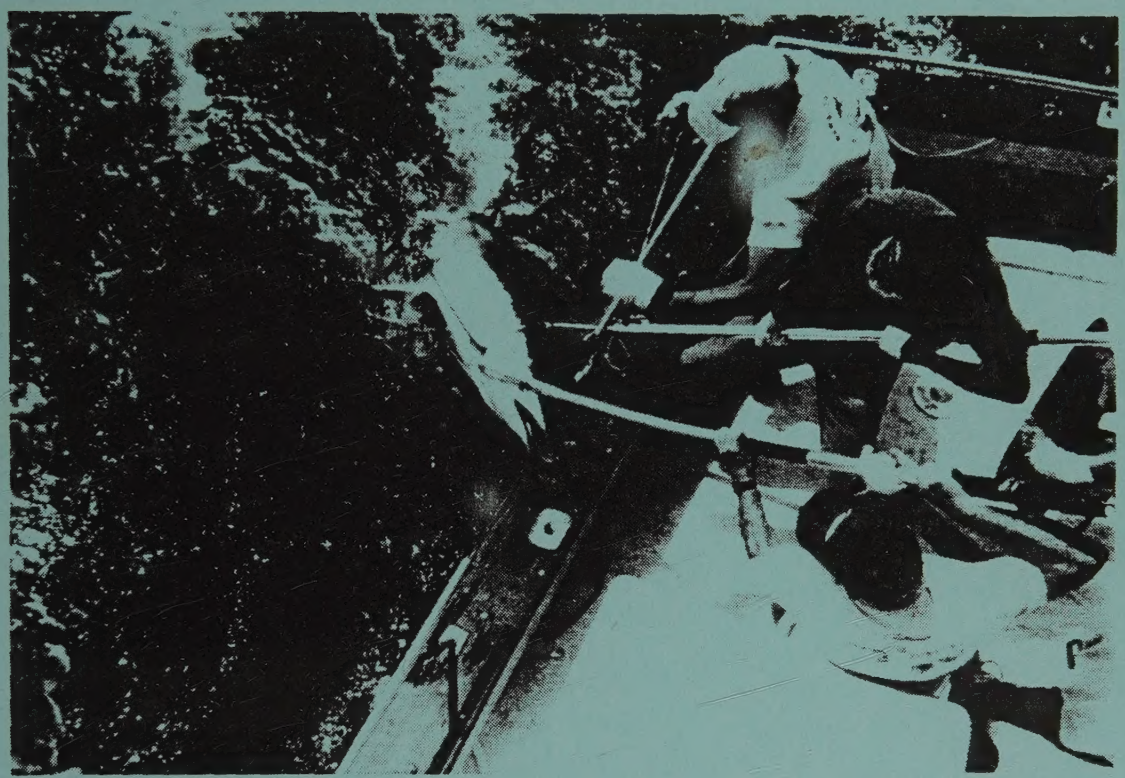
Pelagic Fisheries of the Western Pacific Region

1993 Annual Report



August 1994

Library
NOAA, National Marine Fisheries Service
SWFC Honolulu Laboratory F/SWC2
2570 Dole Street
Honolulu, HI 96822-2396

WPFMC
Pelagics
Ann.
Rep.
1993

Western Pacific Regional Fishery Management Council
1164 Bishop Street, Suite 1405, Honolulu, Hawaii 96813

NMFS Honolulu Library
00000000005739

Pelagic Fisheries of the Western Pacific Region

1993 Annual Report

August 1994

Prepared by the Pelagics Plan Team and Council Staff

for the

Western Pacific Regional Fishery Management Council
1164 Bishop Street, Suite 1405, Honolulu, Hawaii 96813
Telephone (808) 522-8220, Fax (808) 522-8226

On the cover:
The crew of the Oahu charterboat *Maggie Joe* pulls in a blue marlin
(photo courtesy Maggie Joe and Inter-Island Sportfishing)

A report of the Western Pacific Regional Fishery Management Council pursuant to
National Oceanic and Atmospheric Administration Award No. NA17FC0062-02

Contents

page

Introduction 1
Background 1
Report Content 3
Report Appraisal 3
1993 Plan Team Members 4

Summary 7

Issues 11

Recommendations 13

Plan Administration and Enforcement 15
Administrative Activities 15
Protected Species Conservation 16
Enforcement Activities 18
Habitat Issues 19

Tables

page

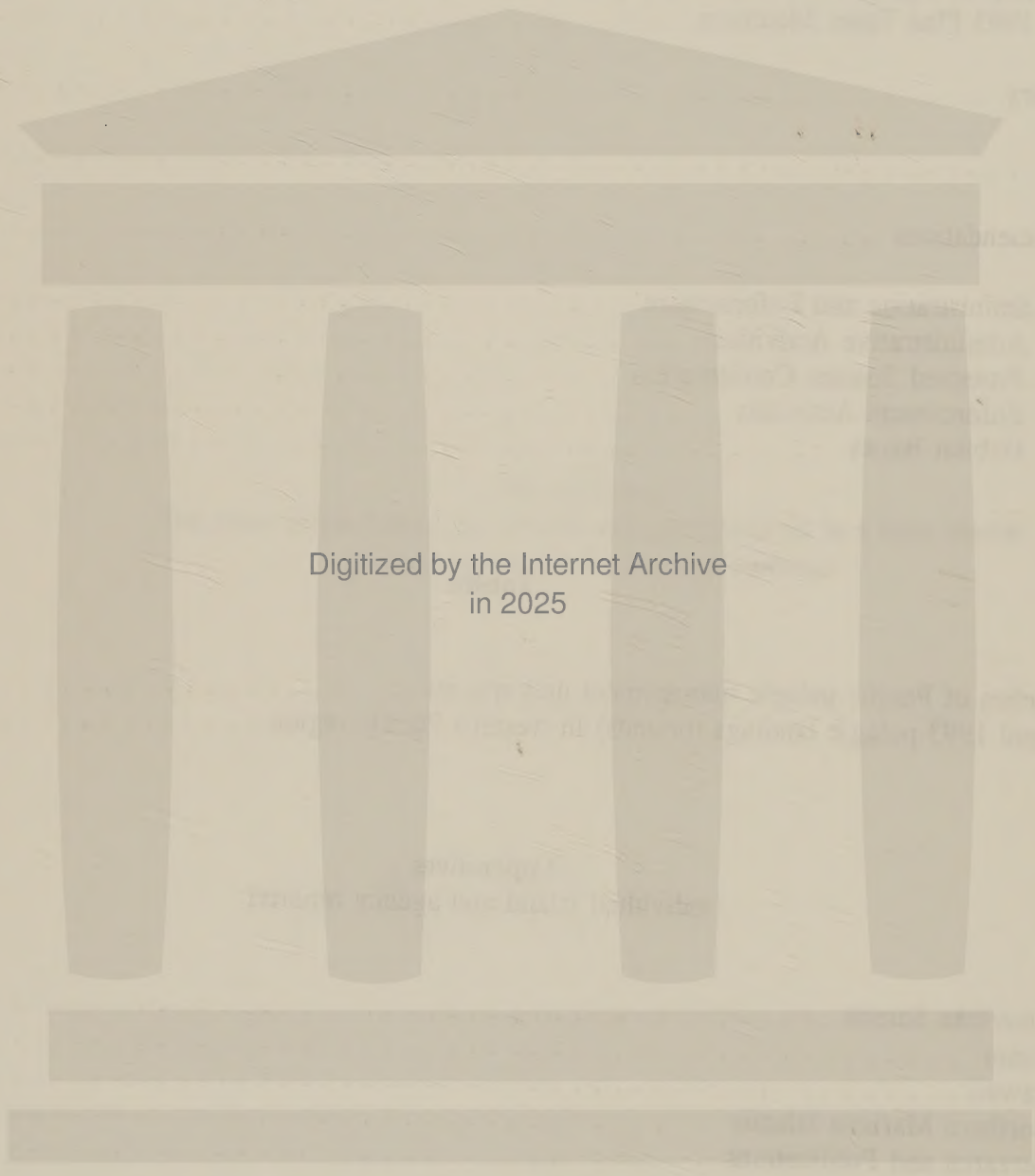
1. Names of Pacific pelagic management unit species 5
2. Total 1993 pelagic landings (pounds) in western Pacific region 6

Appendices

(individual island and agency reports)

page

1. American Samoa 1-1
2. Guam 2-1
3. Hawaii 3-1
4. Northern Mariana Islands 4-1
5. Research and Publications 5-1



Digitized by the Internet Archive
in 2025

https://archive.org/details/pelagic-fisheries-western-pacific-region-annual-report_1993

Introduction

Background

The Fishery Management Plan (FMP) for the Pelagic Fisheries of the Western Pacific Region was implemented by the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) on 23 March 1987. The Western Pacific Regional Fishery Management Council (WPRFMC or Council) developed the FMP to manage the pelagic resources covered by the Magnuson Fishery Conservation and Management Act of 1976 and occurring in the US Exclusive Economic Zone (EEZ) around American Samoa, Guam, Hawaii, the Northern Mariana Islands, and other US possessions in the Western Pacific Region (Johnston Atoll, Kingman Reef & Palmyra Island, Jarvis Island, Howland and Baker Islands, and Wake Island).

The objectives of the Pelagics FMP were revised in 1991. The abridged objectives are to:

- Manage fisheries for management unit species to achieve optimum yield.
- Promote domestic harvest of, and domestic fishery values associated with, Pacific pelagic management unit species, or PPMUS[1] (e.g., by enhancing the opportunities for satisfying recreational fishing experience, continuation of traditional fishing practices, and domestic commercial fishermen to engage in profitable operations).
- Diminish gear conflicts in the EEZ, particularly in areas of concentrated domestic fishing.
- Improve the statistical base for conducting better stock assessments and fishery evaluations.
- Promote formation of regional/international arrangements for assessing and conserving PPMUS throughout their range.
- Preclude waste of PPMUS associated with longline, purse seine, pole-and-line or other fishing operations.
- To promote domestic marketing of PPMUS in American Samoa, Guam and Hawaii.

[1] The Magnuson Act was amended to allow the inclusion of tunas in US fishery management authority as of January 1992. In the Pacific, tuna management is the responsibility of the regional fishery management councils. Pacific pelagic management unit species (PPMUS) includes former pelagic management unit species (PMUS) and tunas.

The Pacific pelagic management unit species (PPMUS) are[2]:

Common Name	Scientific Name
Mahimahi (dolphinfishes)	*Coryphaena* spp.
Wahoo	*Acanthocybium solandri*
Blue and black marlins	*Makaira* spp.
Striped marlin and shortbill spearfish	*Tetrapturus* spp.
Swordfish	*Xiphias gladius*
Sailfish	*Istiophorus platypterus*
Requiem sharks (oceanic species)	family Carcharhinidae
Thresher sharks (oceanic species)	family Alopiidae
Mackerel sharks (oceanic species)	family Lamnidae
Hammerhead sharks (oceanic species)	family Sphyrnidae
Yellowfin, bigeye, albacore, and bluefin tunas	*Thunnus* spp.
Skipjack tuna	*Katsuwonus pelamis*
Kawakawa	*Euthynnus affinis*
Frigate and bullet tunas	*Auxis* spp.
Slender tuna	*Allothunnus fallai*
Dogtooth tuna	*Gymnosarda unicolor*
Mackerel	*Scomber* spp.
Moonfish[3]	*Lampris* spp.
Oilfish	family Gempylidae
Pomfret (oceanic species)	family Bramidae

Non-tuna PPMUS are sometimes referred to as "other PPMUS" in this report. This term is equivalent to the PMUS (Pelagic Management Unit Species) used in annual reports previous to 1992, before tunas were included in the management unit.

The PPMUS are caught in the troll, longline, handline, and pole-and-line (baitboat) fisheries. They are caught in oceanic as well as insular pelagic waters. Most of these species are considered to be epipelagic because they occupy the upper most layers of the pelagic zone. All are high-level predators in the trophic sense. Pelagic fisheries for PPMUS are among the most important, if not the dominant, Pacific island fisheries.

The FMP requires the Council's Pelagic Plan Team (Team) to prepare an annual report on the status of the pelagic fisheries taking place in each of the island areas served by the Council (American Samoa, Guam, Hawaii, and Northern Mariana Islands), evaluate the effectiveness of the FMP in meeting its goals and objectives, and make recommendations for future management and administrative action.

---

[2] Classifications in this table follow Amendment 6 to the FMP, effective 27 November 1992.

[3] Moonfish, oilfish, and pomfret were added to the FMP by Amendment 7, effective on 24 June 1994.

Report Content

This report contains fishery performance data from each of the four island groups through 1993, interpretations of trends or important events occurring in the fisheries, and recommendations.

This report was prepared using reports submitted by the following agencies:

- Territory of American Samoa, Department of Marine and Wildlife Resources
- Territory of Guam, Division of Aquatic and Wildlife Resources
- State of Hawaii, Department of Land and Natural Resources, Division of Aquatic Resources
- Commonwealth of the Northern Mariana Islands, Division of Fish and Wildlife
- National Marine Fisheries Service, Southwest Region (including Southwest Fisheries Science Center Honolulu Laboratory, Pacific Area Office, and Office of Enforcement)
- US Coast Guard District 14
- Pacific Fisheries Research Program, University of Hawaii

The Hawaii report is an integration of State of Hawaii and NMFS summaries.

Tables listing local names of pelagic species and regional landings were added to the introduction.

Report Appraisal

Report content has not changed significantly from previous years. The Team did not expand or improve on the use of fishery indicators this year. However, the Team plans to begin developing quantitative fishery indicators for the Pacific pelagic fisheries in 1994.

1993 Plan Team Members

American Samoa:

Ms. Suesan Saucerman
Dept. of Marine & Wildlife Resources
P.O. Box 3730
Pago Pago, AS 96799
Tel: (684) 633-4456
Fax: (684) 633-5944

Guam:

Mr. Robert Myers
Div. of Aquatic & Wildlife Resources
Department of Agriculture
P.O. Box 2950
Agana, GU 96910
Tel: (671) 734-5283
Fax: (671) 734-6570

Hawaii:

Dr. Robert Skillman
Dr. Christofer Boggs
Mr. David Hamm
Dr. Samuel Pooley
Dr. Jerry Wetherall
Honolulu Laboratory
National Marine Fisheries Service
2570 Dole St.
Honolulu, HI 96822
Tel: (808) 943-1221
Fax: (808) 943-1290

Dr. Richard Brock
University of Hawaii Sea Grant
1000 Pope Rd.
Honolulu, HI 96822
Tel: (808) 956-8191
Fax: (808) 956-2858

Mr. Walter Ikehara, Chair
Division of Aquatic Resources
Dept. of Land & Natural Resources
1151 Punchbowl Street #330
Honolulu, HI 96813
Tel: (808) 587-0096
Fax: (808) 587-0115

Dr. John Sibert
SOEST/JIMAR
University of Hawaii
1000 Pope Rd., MSB 312
Honolulu, HI 96822
Tel: (808) 956-4109
Fax: (808) 956-4104

Mr. Gordon Leslie
RR1, Box 179
Captain Cook, HI 96704
Tel: (808) 328-9060

Dr. John Kaneko
Pacific Management Resources, Inc.
3615 Harding Ave.
Honolulu, HI 96816
Tel: (808) 735-2602

Mr. James Witten
1639 Kamole St.
Honolulu, HI 96821
Tel: (808) 373-4229

Northern Mariana Islands:

Mr. John Gourley
Division of Fish & Wildlife
Department of National Resources
Saipan, MP 96950
Tel: (670) 322-9729
Fax: (670) 322-3386

Annual Report Coordinator and Editor

Mr. Robert Harman
Western Pacific Regional Fishery
Management Council
1164 Bishop St. #1405
Honolulu, HI 96813
Tel: (808) 522-8220
Fax: (808) 522-8226

Table 1. Names of Pacific pelagic management unit species

English Common	Scientific	Samoan or AS local	Hawaiian or HI local	Chamoru or Guam local	S. Carolinian or NMI local	N. Carolinian or NMI local
Mahimahi (dolphinfish)	*Coryphaena* spp.	Masimasi	Mahimahi	Botague	Sopor	Habwur
Wahoo	*Acanthocybium solandri*	Paala	Ono	Toson	Ngaal	Ngaal
Indo-Pacific blue marlin; Black marlin	*Makaira mazara; M. indica*	Sa'ula	A'u, Kajiki	Batto'	Taghalaar	Taghalaar
Striped marlin	*Tetrapterus audax*		Nairagi			
Shortbill spearfish	*T. angustirostris*	Sa'ula	Hebi	Spearfish		
Sailfish	*Istiophorus platypterus*	Sa'ula	A'u lepe	Guihan layak	Taghalaar	Taghalaar
Swordfish	*Xiphias gladius*	Sa'ula malie	Broadbill, Shutome	Swordfish	Taghalaar	Taghalaar
Moonfish	*Lampris* spp.	Koko	Opah		Ligherigher	Ligherigher
Oilfishes	*Ruvettus pretiosus; Lepidocybium flavobrunneum*	Palu-talatala	Walu, Escolar		Tekineepek	Tekineepek
Pomfret	Bramidae	Manifi moana	Monchong			
Oceanic sharks	Alopiidae; Carcharinidae; Lamnidae; Sphyrnidae	Malie	Mano	Halu'u	Paaw	Paaw
Albacore	*Thunnus alalunga*	Apakoa	Ahi palaha, Tombo	Albacore	Angaraap	Hangaraap
Bigeye tuna	*T. obesus*	Asiasi, To'uo	Mebachi, Ahi po'o nui	Bigeye tuna	Toghu, Sangir	Toghu, Sangir
Yellowfin tuna	*T. albacares*	Asiasi, To'uo	Ahi, Shibi	Yellowfin tuna	Toghu	Toghu hangar
Northern bluefin tuna	*T. thynnus*		Maguro			
Skipjack tuna	*Katsuwonus pelamis*	Atu, Faolua, Ga'oga	Aku	Bunita	Arangaap	Hangaraap
Kawakawa	*Euthynnus affinis*	Atualo, Kavalau	Kawakawa	Kawakawa	Asillay	Hailuway
Dogtooth tuna	*Gymnosarda unicolor*	Tagi	Hagatsuo	Dogtooth or White tuna	Ayul	Owel
Other tuna relatives	*Auxis* spp.; *Scomber* spp.; *Allothunnus* spp.	(various)	Ke'o ke'o Saba (various)	(various)	(various)	(various)

Table 2. Total 1993 pelagic landings[4] (pounds) in western Pacific region

Species	American Samoa	Guam	Hawaii	Northern Marianas	TOTAL
Mahimahi	4,834	423,988	771,000	30,036	**1,229,858**
Wahoo	3,083	97,448	478,000	2,257	**580,788**
Blue marlin	7,599	98,698	1,472,000	2,950	**1,581,247**
Black marlin*			15,000		**15,000**
Striped marlin			1,291,000		**1,291,000**
Spearfish*		469	29,000	309	**29,778**
Sailfish*	1,037	2,379	2,000	96	**5,512**
Swordfish			13,486,000		**13,486,000**
LL Misc. billfish			270,000		**270,000**
Yellowfin tuna	18,989	76,285	3,947,000	11,919	**4,054,193**
Bigeye	86	12,222	4,208,000		**4,220,308**
Albacore	199		1,225,000		**1,225,199**
Skipjack*	25,720	135,163	2,468,000	77,832	**2,706,715**
Kawakawa*	88	962	17,000		**18,050**
Dogtooth	1,924	3,024		1,979	**6,927**
LL Misc. tunas		24	150,000	833	**150,857**
Sharks	576	902	2,602,000		**2,603,478**
Barracuda	1,691	3,522		27	**5,240**
Rainbow runner*	67	3,859	3,000	644	**7,570**
Moonfish*					**0**
Pomfret*					**0**
Troll fish				16,232	**16,232**
LL Misc. pelagics			430,000		**430,000**
TOTAL	**65,893**	**858,945**	**32,864,000**	**145,114**	**33,933,952**

* NMFS Hawaii longline logbook summaries aggregate several billfish and tuna species (noted with *) into miscellaneous billfish, tuna, and pelagics categories. These miscellaneous categories are noted in the table with LL prefixes. Where HDAR troll, handline, and pole-and-line summaries produce individual totals for those species, they are listed in the table and are not included in the LL miscellaneous categories.

[4] Landings are reported in island reports (Appendices 1-4), which include recreational and commercial landings data, where available (e.g., for Hawaii, only commercial landings). In some cases, totals may not add precisely due to rounding.

Summary

1) The Council took several **management actions** in 1993. A new regulation requires the marking of longline floats and buoys, whether deployed in the EEZ or possessed on board the vessel. Also, federal regulations implemented under the Preliminary Management Plan governing foreign longline fishing for pelagic species in the EEZ of the Northern Mariana Islands and the west coast of the US mainland were removed. See Administrative Activities for details.

Amendment 7 to the Western Pacific Pelagic Fisheries FMP to establish a limited entry program for the Hawaii based longline fishery was implemented by final rule (50 CFR 685) and took effect on 24 June 1994.

No permits were requested by any foreign nation to fish in the US EEZ of the Western Pacific region in 1993.

2) In **American Samoa**, total landings decreased 41% to 65,893 lb from 1992, dropping to the lowest level since 1982. Most of the change is due primarily to a 64% decline in skipjack landings, despite increased non-tuna PPMUS landings and more boats fishing. Total **revenue** declined 33% ($91,897), due largely to the decline in tuna revenues (-43%). This is despite the fact that prices for tunas and non-tunas were at a new high or matched previous highs.

The **number of boats** in the pelagic fishery increased 48%, reversing the decline shown since 1988. Forty vessels made 536 trips, but the trips per boat and hours per trip both decreased, so total effort decreased. Trolling was the primary method used. Catch rates for non-tuna PPMUS rose, while tunas decreased.

Frozen fish purchased or bartered from foreign longline vessels moored in Pago Pago Harbor competed with pelagic fish landed by domestic fishermen. In some cases, Samoan fishermen acted as middlemen in the transactions between longliners and the market. Poor documentation of these transactions made it difficult to assess the impact of these exchanges on the market for fresh fish that were supplied by local fishermen. On the other hand, the market share of documented imports of pelagic fish declined from 66% of the total market in 1990 to just 3% in 1993.

3) **Guam** landings of all pelagics (858,945 lb) increased by 25%, exceeding the 13-year peak in 1991. Total revenue rose 11% ($547,835) and adjusted revenue increased 3%. Non-tuna PPMUS landings (+61%) and adjusted revenue (+16%) rose, while tuna landings (-24%) and adjusted revenue (-17%) fell. The big increase was due almost entirely to another big peak in mahimahi landings, such as occurred in 1991. Mahimahi made up 49% of the total pelagic landings, followed by skipjack (16%), blue marlin (11%) and wahoo (11%). The marlin catch decreased after a broad peak from 1989 to 1992, probably due to reduced charterboat activity as a result of a decline in tourism. The average size of yellowfin tuna in the International Fishing Derby declined somewhat, but the winning fish was larger than in 1992.

Guam's adjusted **prices** have continued to decline since 1980 while adjusted total **revenues** were near the 1980-92 averages for both other PPMUS and tunas. The decline is due, at least in part,

to the entry of tunas from foreign vessels through irregular marketing channels and other marketing problems.

The estimated **number of trolling vessels** reached a record high of 309, continuing a generally rising trend. The number of trips (-2%), hours fished (+3%), and hours per trip (+5%) changed little from 1992.

4) The **Hawaii** fisheries for PPMUS produced total landings for all pelagic species of 32.9 million lb in 1993, a 20% increase from 1992. Swordfish landings (13.5 million lb) were up 7%, compared to the 27% increase in 1992 and the 136% increase in 1991. Swordfish continued to be the dominant species in the pelagic fishery, exceeding combined tuna landings. Striped marlin landings were up 18%. Mahimahi landings were down 27% from 1992 and slightly below the seven-year average. Combined tuna landings (12 million lb) were up 26%, with catches of all species higher than in 1992.

Total **revenue** increased 17% to $63.5 million and total adjusted revenue rose 14%. The inflation-adjusted ex-vessel revenue from the sale of pelagic species for the longline fishery has steadily been increasing, and at a rate faster than landings. In contrast, adjusted revenue of the troll and handline fisheries has decreased since 1987, and has barely kept up with inflation, particularly in recent years.

Catch rates for trollers generally decreased slightly from 1992, while handline and baitboat catch rates generally increased, except for handline bigeye. The handline yellowfin catch rate rose to a record high in 1993.

The Hawaii **longline** fleet landed 26 million lb of pelagic fish, maintaining a steady increase since 1987. Of the billfish landed in Hawaii, longlining accounted for almost all of the swordfish and striped marlin, and about half of the blue marlin. Roughly 60% of the longline landings (approx. 15.7 million lb) were billfish (almost all were swordfish), compared with 0.89 million lb (19%) landed by the troll and handline fisheries (most were blue marlin). Estimated shark catches were much higher in 1993 due to substantial landings of shark fins by longline vessels. A recent development for Hawaii was that bluefin tuna, *Thunnus thynnus*, were landed in 1993 by longliners as they fished increasingly further north of Hawaii. Hawaii's **troll and handline** landings of pelagics increased to 4.7 million lb, near the seven-year average of 4.6 million lb. Yellowfin tuna and wahoo were the major species caught predominantly by troll and handline vessels.

Fishing effort for the combined pelagic fisheries in Hawaii remained at a high level in 1992. The number of longline vessels increased from around 40 in 1983-87 to nearly 140 in 1990. Then, in 1991, the number of active vessels declined to 111, as boats left the fishery and could not be replaced under the rules of a Council-imposed moratorium on new participants. In 1993, 122 vessels were active in the fishery, and although the number of trips decreased by 5%, the number of sets increased 7%. The number of trips by the troll fishery increased 3% to 20,647, and though slightly higher than the 1979-93 average of 16,976, has remained nearly stable since 1986. The number of trips taken by skipjack tuna baitboats dropped 6% from 1992, dipping below the long-term average. The number of handline trips continued a decreasing trend since 1987, but with only a small drop from 1992 (-0.7%).

The Hawaii Department of Health **prohibited the marketing of oilfishes** (walu, *Ruvettus pretiosus*, and escolar, *Lepidocybium flavobrunneum*) in March 1994, following similar action by the US Food and Drug Administration.

5) Landings of all pelagics in the **Northern Mariana Islands** (NMI) decreased 11% to 145,115 lb, but skipjack tuna landings, the largest component of the total landings, increased somewhat (+18%) in 1993, reversing a long-term decline. The decline in commercial landings for the last several years were due to poor skipjack tuna seasons, despite record landings of some other species. Skipjack landings were well below the long-term average. Landings of mahimahi set a new record from the previous record high in 1991. Wahoo landings dropped 84% from the near-record 1992 landings, falling below the long-term average. Blue marlin landings decreased 45%, but remained slightly above the long-term average.

Total **revenue** dropped 19% ($249,136) and adjusted total revenue fell 22%.

The **number of fishermen** landing pelagic fish declined to a new low after the record high of 1992. Despite that, the number of trips landing PPMUS has remained fairly constant throughout the 11-year sample period. It is possible that the number of trips may be inflated due to multiple reporting.

The inflation-adjusted **price** of non-tuna PPMUS decreased, and was below the long-term average. The adjusted price of tunas also decreased, but was above the 11-year average. The adjusted revenues per trip reached record lows in 1993 and were well below the long-term averages.

6) The **swordfish** longline fishery in Hawaii began in 1989 with landings estimated at 0.6 million lb, increasing to 3.4 million lb in 1990, and to 13.5 million lb in 1993. The average size of swordfish rose dramatically in 1992, perhaps due to new areas being fished by longliners. The average size was slightly smaller in 1993, but remained larger than in 1990-91. Swordfish comprised the largest proportion of the total non-tuna landings by all fisheries in Hawaii for the fourth consecutive year (72% in 1993, 73% in 1992, 62% in 1991, and 38% in 1990). Swordfish landings from non-longline gear were negligible in comparison. Other areas did not report landings of swordfish.

7) In American Samoa, **blue marlin** landings were 64% higher than 1992, and much higher than the ten-year average from 1983-92. Guam landings of blue marlin were nearly the same (-2%) as 1992, ranking third behind mahimahi and skipjack tuna. Blue marlin landings (1.5 million lb) in Hawaii were above the seven-year average from 1987-93, registering a 15% increase from 1992. Longline accounted for 53% of the total blue marlin landings. Blue marlin landings in the Northern Marianas decreased 45% from 1992's record peak and remained slightly above the 11-year mean.

The catch rate of blue marlin in the American Samoa troll fishery increased to a record high. In Guam, blue marlin troll catch rates declined from a record high 1990-91 levels, although catch rates have increased slowly since 1980. The catch rate of blue marlin in the Hawaii troll fishery rose in 1993, but was within the long-term average. In the Northern Marianas, the 1993 marlin catch rate declined from the peak in 1992, but remained higher than the 11-year average of 1.91 lb/trip.

The average size of blue marlin in the Guam International Fishing Derby was slightly larger in 1993, and was not significantly different from the 1977-93 average (158 ±41 lb).

8) **Striped marlin** landings ranked third among the billfish in Hawaii (after swordfish and blue marlin), where it accounted for 6% of the commercial landings of non-tuna PPMUS. The 1993 landings of 1.3 million lb were 18% higher than 1992 landings and higher than the 1987-93 average. Striped marlin is regarded as a secondary target species (after bigeye tuna) in the winter longline fishery, and it ranked second after swordfish in total longline landings of billfish. Landings in the Hawaii troll and handline fisheries reached a new peak, well above the long-term average. The species rarely appears in the domestic landings from other areas.

9) **Shortbill spearfish** made up less than 1% of the PPMUS landings in Hawaii, and rarely appeared in the landings reported for other areas. Black marlin and other miscellaneous billfish were rare in all fisheries.

10) **Sailfish** landings were insignificant in all areas.

11) **Mahimahi** landings (4,834 lb) in American Samoa increased 143% from 1992, reversing a decline since 1988. Guam's mahimahi landings rose to a new record high of 423,988 lb, 69% of non-tuna PPMUS landings and 49% of all pelagic landings. The trolling catch rate also increased dramatically from 1992. Mahimahi landings (0.8 million lb) made up 4% of the 1993 non-tuna PPMUS landings in Hawaii, a 27% decrease from 1992. The longline fishery accounted for 34% of the 1993 landings. The troll catch rate in Hawaii decreased slightly, but it was near the 15-year average. Northern Marianas mahimahi landings reached a record high of 30,036 lb, or 80% of the non-tuna PPMUS landings. The trolling catch rate increased 47%, but did not exceed 1991's record catch rate.

12) **Wahoo** landings in American Samoa (3,083 lb) declined slightly, but remained high. The catch rate was also high. Guam's wahoo landings (97,448 lb) decreased by 14%, but was near the 1980-92 average (84,628 ±30,335 lb). Catch rates followed a similar trend. Wahoo landings in Hawaii for 1993 (0.5 million lb) increased about 25% from 1992, and was slightly higher than the 1987-93 average. The trolling catch rate data for Hawaii indicate that wahoo availability has remained fairly steady since 1979. Northern Marianas wahoo landings (2,257 lb) dropped from the record peak in 1992, and was below the long-term average. The similarities among landings and catch rate trends in Guam, the Northern Marianas, and American Samoa seen in 1992 were not repeated for wahoo in 1993.

13) Reported Hawaii **shark** landings in 1993 were much higher than previous years. The increase is due to new estimates derived from landings of shark fins. Shark landings from other areas were relatively minor.

14) **Yellowfin tuna** landings in American Samoa declined 23% to 18,989 lb, although catch rates were a little higher than 1992. Decreased effort was probably the cause of the decline. Guam yellowfin landings (-49%, 76,285 lb) and catch rate (-56%) were almost half 1992 landings and catch rate. There has been a general decline in the catch rates since about 1985 (except for a peak in 1992) indicating decreasing availability of yellowfin in the Guam area. Total Hawaii landings of yellowfin (3.9 million lb) were 30% higher than 1992 and higher than the 1987-93 average, and higher landings were made by trollers and handliners than by

longliners. The trolling catch rate dipped slightly (-11%) but the handline catch rate continued a steady climb from 1990. NMI yellowfin landings were much lower (-42%, 11,919 lb) than 1992's record high and below the 11-year mean. Catch rates were correspondingly lower as well. Yellowfin have never been a major component of NMI tuna landings.

15) **Skipjack tuna** landings in American Samoa in 1993 were much lower (-64%, 25,720 lb) than 1992. The catch rate fell from the 1992 peak, and was below the 1982-93 mean. Guam skipjack landings (135,163 lb) and catch rate were almost the same as 1992. Hawaii skipjack landings (about 2.5 million lb) were lower than 1992, and were caught mainly by baitboats. The troll skipjack catch rate was slightly lower than 1992, while the baitboat catch rate was much higher than 1992. NMI's 1993 skipjack landings were 18% higher (77,832 lb) than 1992, but has been in a steep decline since 1989. Although the catch rate rose 24% from 1992, it was still far below the 1983-93 mean.

16) Guam reported landings of 12,222 lb of **bigeye tuna** in 1993. Total Hawaii landings of bigeye increased 20% (to 4.2 million lb), almost all caught by longline. No other areas reported bigeye landings.

Hawaii total landings of **albacore** increased 33% and reached a new peak (1.2 million lb). About 89% of albacore were landed by longliners. Other areas did not report landings of albacore.

17) **Troll fisheries** dominated the domestic fisheries in American Samoa, Guam and the Northern Marianas, in contrast to Hawaii where the longline sector caught more PPMUS than the other sectors. Growing charter fishing businesses in Guam and Northern Marianas contributed heavily to troll fishing effort. There were no domestic longliners operating in American Samoa, Guam, or Northern Marianas in 1993, and pelagic handline fishing has not been established in any areas other than Hawaii.

18) The **US purse seine** harvest within the western Pacific region's EEZ was 13,564 tons. Of this, 12,243 tons were skipjack tuna and 1,321 tons were yellowfin tuna. All of this catch was made in the EEZ around Howland and Baker Islands (no purse seine catch was reported from the EEZ of American Samoa. The total US purse seine catch was reported to be just over 208,000 tons.

Issues

The Team reviewed several issues that have been raised over the past few years, such as problems in the Hawaii tuna handline fishery, the lack of data collection in non-longline fisheries, competition for blue marlin catches, and possible larger minimum sizes and bag limits for tunas in Hawaii. The Team suggested that a working group, comprised of scientists and fishermen, be formed to address these "small boat" issues. The Team felt that the working group should focus on several aspects of the handline fishery issue, but that they should also feel free to take up other small-boat topics as they see fit. Ultimately, the working group would make recommendations to the Council for possible management action or further work. The Team stressed that some members of the Pelagics Plan Team, Pelagics Advisory Panel and enforcement agencies be included in the working group to ensure continuity and familiarity with

the issues. Although the Team did not discuss the following issues in detail, it was suggested that the "small-boat pelagics working group" could decide which of the issues to address, and consider ways to effectively treat some of them:

1. Analyses required to develop recommendations to Council regarding federal management of the handline fishery. Some of these analyses are beyond the scope of a small boat working group, and some are in progress by various agencies. They are all listed here for completeness:

Effectiveness of management alternatives
- A. Limited entry (or moratorium)
- B. Fish size limits
- C. Season or area closures
- D. Marketing cooperatives
- E. Individual fishermen's quotas

Economic analyses of available data
- A. Market structure - local supply, demand and shipping dynamics
- B. Product form - quality, size
- C. Market competition
  - 1) within handline fishery
  - 2) between handline and other fisheries
  - 3) effects of imports
- D. Revenue per unit effort

Biological analyses of available data
- A. Catch competition - potential impacts of the handline fishery (inshore and offshore) on local abundance of tunas in all pelagic fisheries
- B. Potential impacts of the handline fishery (inshore and offshore) on stocks of tunas
  - 1) size/age structure
  - 2) stock abundance

Social analyses
- A. Implications within handline fishery of preferred management action (e.g., permits & transfers, impacts on specific fishery sectors, vessel upgrading, preferential rights for natives, prior investment, etc.)
- B. Implications of management on other local fisheries
- C. Enforcement of regulations
- D. Purpose of, and access to, NOAA weather buoys (and potential loss)

2. Investigate the desirability and feasibility of increasing the minimum size for sale for *ahi* (bigeye and yellowfin tunas) to <u>at least</u> 10 lb.

3. Investigate the desirability and feasibility of establishing a non-commercial (i.e., recreational and subsistence) bag limit on *ahi*.

4. Evaluate desirability and effectiveness of the management options identified last year by the blue marlin working group:

Management Options Identified at Blue Marlin Workshop:

Management options ranked "high":
At a minimum, maintain area closures and some form of limited entry management of the longline fishery. Initiate a program to collect data including establishing logbooks from all sectors of the fishing industry.

Explore limiting longline permits and establishing a limited entry permit system for trollers to land blue marlin; transferable permits to be included.
Encourage releasing and, where appropriate, tagging of billfish.
No entry of purse seiners in Hawaiian EEZ.
Discourage killing of large marlin during the spawning season.

Other management options considered:
Ban sale of all blue marlin.
Set management trigger limits.
Double closure areas in Hawaiian waters; restrict non-Hawaii based longliners.
Dead fish on line should be donated for consumption.
Regulate access of all trollers in key charter fishing grounds.
Manage recreational industry with licenses.
Bag limits of 2 fish per day for charters; rest for tag/release.
Increase license fees for blue marlin.
Remove FADs from key charter boat fishing grounds.
Consider establishing marine reserves in key marlin areas.
Put observers on longline vessels.
Establish non-restriction zone and/or seasons for trolling boats and charters.
Separate zones for gear types.
Limit possession, landing and or sales to trolling and hand lines; release all others.
Allow controlled expansion outside EEZ. Each vessel is given a blue marlin catch quota. When a boat's quota is reached the season for the vessel is closed.
Recognizing the need for more research, build on the strength of PORF, and encourage additional funding for blue marlin research.

5. Evaluate the desirability and feasibility of a mandatory daily fishing trip logbook for all small-boat fishermen in the main Hawaiian islands, including full- and part-time commercial, recreational and subsistence. The log would report date, catch (numbers and estimated weight, including releases and losses, or non-landed catch), effort, location, value, interactions with protected species and other details important to management.

Recommendations

Many of the recommendations listed below are related to improving data collection for management purposes. The Team noted that improved collaboration among the Council and federal, state, and territorial agencies have resulted in substantial improvements in the fishery statistical systems in American Samoa, Guam and the Northern Mariana Islands, as well as some improvements in the quality and coverage of Hawaii fishery statistics. However, reliable estimates of the total catches are not available, and the quality and completeness of the existing Hawaii statistics have never been quantitatively assessed. Without estimates of total catches in the region or total catches made by pelagic fishing fleets operating out of Hawaii ports, and without knowing the reliability of any estimates that are made, the Team cannot effectively monitor the fisheries and assess the stocks and the Council, in turn, cannot effectively manage the pelagic fisheries.

The Team made several recommendations, which the Council endorsed at its meeting in Kailua-Kona, Hawaii, in August 1994:

1) The appropriate agency or agencies should conduct a survey of Hawaii small-scale fisheries that are not covered (at all or only partially) by the Hawaii data collection system.

This in effect would be a full implementation of the Council/NMFS/HDAR small-boat pilot survey conducted successfully several years ago. Such a survey would provide an estimate of the non-commercial catches in Hawaii. The Team believes that such a survey might not need to be conducted more frequently than every five years, nor less frequently than every ten years.

2) The appropriate agency or agencies should conduct a survey to determine the coverage rate of the commercial fisheries by the HDAR data collection system.

While the HDAR fishery statistical system is designed to be a complete enumeration, it is not, and probably never could be, no matter how many resources were dedicated to it. A survey would allow raising the estimates available from the HDAR fishery statistics system. The Team believes that, if a dealer reporting system was also implemented (see below), then a coverage survey would need to be conducted only infrequently, say every ten years (or more frequently if some significant change in coverage is suspected).

3) The HDAR should implement and conduct a dealer permitting/reporting system to estimate the total amount and value of fish sold in the State.

These data will complement the fish catch report data reported by fishermen. As with the fish catch report system, enforcement and routine processing of the data forms are critical for successful working of such a system. The resulting data should be captured in computer-compatible format.

4) The HDAR should improve the collection of fisheries data so that useful effort information becomes available. The HDAR should enter into the database all information that is reported on forms, especially header information that would identify the beginning and end of multi-day trips.

The current State catch reporting system lacks information necessary to adequately define troll and handline effort, and to address interaction among gears. In the future, it is highly desirable that detailed effort information (e.g., to calculate fish/hook/hour catch rates) be obtained from the troll and handline fleets.

In addition, more effort should be put into educating fishermen and dealers about proper data reporting, as well as enforcement of the reporting requirements.

5) NMFS and the US high-seas purse seine industry should routinely report catch by species (including bycatch) and fishing effort of pelagic fishes within the individual US EEZ areas of the Western Pacific Region.

The Team suspects that these catches may well amount to the largest or second largest fishery in the entire Council region. NMFS reports indicate that considerable purse seine fishing is occurring in 1994 around US possessions in the western Pacific. The Council should attempt to collect and analyze fishery and bycatch information from purse seine fisheries in the region, especially US seiner data from US EEZ areas.

6) The three fishery management councils with pacific jurisdictions, along with the NMFS, should collaborate to ensure the collection of landing and logbook data from all domestic

longline and driftnet vessels harvesting swordfish and other Pacific Pelagic Management Unit Species (PPMUS).

Currently, longline vessels operating out of California and Alaska are fishing the same or nearly the same waters as the regulated fleet based in Hawaii, but they do so without any reporting requirements, state or federal. Without fishery data from all these operations, reliability of assessments of the status of the stocks will be compromised, and the ability of the Council to manage will be undermined.

7) Council should attempt to obtain "bycatch" information from distant-water fisheries, foreign and domestic, for mahimahi, wahoo, marlins, etc. This information may be available from SPC/FFA observer programs.

The Council should also support an analysis of trends in mahimahi and wahoo landings and catch rates throughout the region, particularly in the western Pacific, and including data from EEZ and distant-water fisheries. Mahimahi is an important resource and economic component of island fisheries. The team should initiate a region-wide study of mahimahi landings, catch rates, regional availability patterns, and economics.

The collaborative approach taken by the Western Pacific Yellowfin Working Group -- an international group of scientists -- to assess the status of yellowfin tuna stocks should be expanded to include other PPMUS throughout the central and western Pacific.

8) Team should investigate motivational factors relating to entry and exit patterns in American Samoa, Guam and Northern Marianas pelagic fisheries.

Participation has often fluctuated by orders of magnitude with no documented reasons, except for the occurrence of hurricanes in some instances. More needs to be known about the behavior and motivations of fishermen since these directly affect fishing activity and catch.

9) Team should meet again in 1994 to develop indicators for use in interpreting changes in annual fishery performance, beginning with the 1994 annual report. These indicators might include, for example, substantial changes in fishery parameters (e.g., fish size, revenue, etc.) relative to long-term average, significant shifts in relative proportions of gear types or product forms in any one area, evidence of interactions, or others.

Plan Administration and Enforcement

Administrative Activities (NMFS Southwest Region)

The NMFS Southwest Region prepared, for approval by the Secretary of Commerce and publication in the *Federal Register*, three regulatory actions governing the pelagic fisheries:

16 March 1993 (58 FR 14170)[5] -- Final Rule (effective 15 April). All operators of permitted longline vessels are required to mark longline floats and buoys, whether deployed in the EEZ or possessed on board the vessel. Also, any unmarked longline gear found deployed in the EEZ may be confiscated and disposed of by NMFS.

23 September 1993 (58 FR 49438) -- Final Rule (effective 25 October). Federal regulations implemented under the PMP governing foreign longline fishing for pelagic species in the EEZ of the Northern Mariana Islands and the west coast of the US mainland are removed. This reduces the complexity caused by having two separate management approaches (FMP and PMP) for foreign fishing.

22 December 1993 (58 FR 67669) -- Interim Final Rule (effective 6 January 1994). All Hawaii longline limited entry permit holders are to make accommodations for a NMFS observer when so directed by the Southwest Regional Director. Permit holders or vessel operators must provide NMFS at least 72 hours notice prior to each departure from port so that NMFS can determine if an observer placement will be made.

In 1993, the NMFS Pacific Area Office (PAO) issued or renewed 156 general longline fishing permits allowing domestic longliners to fish within the EEZ of the western Pacific region. There were 166 vessels that were covered by Hawaii longline limited entry permits at some time during the year.

As approved by the Regional Director, the PAO transferred 13 longline limited entry permits to new vessel owners under one-time transfer provision of the moratorium program. Two permits were transferred to replacement vessels.

In 1993, the PAO received 911 notifications that vessels were arriving to port, as required from all longline operators following each trip. The notices were coordinated with the NMFS Honolulu Laboratory and NMFS Enforcement as part of the logbook catch and effort data collection program.

No administrative actions relating to foreign fishing in the western Pacific EEZ were required because no foreign fishing permits were requested for any vessels with which the USA has a Governing International Fishing Agreement.

Protected Species Conservation

Section 7 Consultation. On 10 June 1993, the National Marine Fisheries Service (NMFS) issued a biological opinion under Section 7 of the Endangered Species Act for the incidental take of listed sea turtles in the Hawaii longline fishery.

The incidental take statement (ITS) in the 10 June 1993 biological opinion authorized an incidental take in the Hawaii longline fishery of 752 listed sea turtles, of which 299 may be

[5] 58 FR 14170 is read "*Federal Register*, volume 58, page 14170".

injured or killed during the 12 months that the biological opinion is valid. Reasonable and Prudent Measures outlined in the ITS included:

1) the establishment of a voluntary and subsequently a mandatory observer program;
2) evaluation of observer and logbook data on a quarterly basis;
3) evaluation of methods to determine the fate of incidentally caught turtles released alive;
4) requirements to handle incidentally caught turtles to minimize further trauma and injury; and
5) a requirement to reinitiate consultation 12 months from 10 June 1993.

Observer Programs. Because there were significant differences between the reported rate of interactions with sea turtles from fishing logbooks and from those interactions reported from previous observer trips, one of the Reasonable and Prudent Measures of the ITS was the implementation of an observer program to collect more accurate data. While the mandatory observer requirements and process were proceeding through an amendment to the FMP, the NMFS Pacific Islands Observer Program began placing observers on longline vessels on a voluntary cooperative basis.

Observers were placed on five permitted longline vessels for six fishing trips from 27 July through 9 December 1993. A total of 70 sets were observed.

Total hooks = 82,896
Average hooks per set = 1,184
Total sets = 70
Average hooks per set by trip = 660 to 1,613
Total takes of sea turtles and marine mammals:
1 Green turtle (*Chelonia mydas*)
1 Leatherback turtle (*Dermochelys coriacea*)
3 Loggerhead turtles (*Caretta caretta*)
1 Pygmy killer whale (*Feresa attenuata*)

A logbook summary for the same period was prepared by the Honolulu Laboratory. The rate of incidental take of turtles observed in 1993 was 0.060 turtles per 1,000 hooks. This was consistent with the observed take rate of 0.061 turtles per 1,000 hooks from 1990-92. All of these rates are raw rates, uncorrected for any sampling biases, variance in seasonality or other variables. A pilot sampling protocol was developed by the Honolulu Laboratory for selecting longline vessels from the Hawaii longline fleet for mandatory observer placement. The mandatory observer program went into effect in early 1994.

Hooking Mortality Workshop. A workshop to assess sea turtle mortality from longline fishing activities was held in 1993. The workshop resulted in a report "Research plan to assess marine turtle hooking mortality: Results of an expert workshop held in Honolulu, Hawaii, November 16-18, 1993". Fifteen experts in the fields of sea turtle biology, protected species management, fishery interactions, veterinary medicine, and physiology participated. Technical presentations were provided by the participants on areas of their expertise. The remainder of the workshop was a series of facilitated strategic planning sessions to identify research objectives and activities, and to develop well-rounded multi-disciplinary research projects and programs.

Enforcement Activities

The following report is a combined effort of the US Coast Guard 14th District (USCG) and the NMFS Office of Enforcement.

From 1 January 1993 through 31 December 1993, the USCG conducted 1,096 hours of fisheries patrols with C-130 aircraft in the Western Pacific region, and 297 hours with HH-65 helicopters in the main Hawaiian Islands. The C-130 surveillance was broken down in 20.2 hours in Jarvis and Palmyra/Kingman Reef EEZs, 22.5 hours in Howland and Baker, 16.9 hours in Johnston, 54.2 hours in Wake, 162.5 hours in Guam and NMI, and 77.3 hours in American Samoa. Of the 1,096 hours expended, 78.4 were on high seas driftnet enforcement. During fiscal year 1993, 130 high endurance cutter days were expended.

Some 810 fishing vessels were sighted during this period. Sixty-two USA, three Japanese, one Taiwanese, one Honduran, and three South Korean fishing vessels were boarded. In August 1993, the Coast Guard Cutter (CGC) *Galveston Island* sighted the Taiwanese flagged longline fishing vessel *Der Chang Tsai* fishing inside the US EEZ of Guam. A penalty of $100,000 was awarded to the F/V *Der Chang Tsai*. In September 1993, a C-130 flight sighted the US longline fishing vessel *Princess Mary* fishing inside the main Hawaiian Islands longline fishing prohibited area. The F/V *Princess Mary* was awarded a penalty of $9,375. In October 1993, the CGC *Galveston Island* sighted the Taiwanese flagged longline fishing vessel *Yih Ching Tsai* fishing inside the US EEZ of Guam. The *Yih Ching Tsai* was fined $99,000.

In November 1993, the CGC *Washington* sighted US longline fishing vessel *Captain T&T* fishing inside the main Hawaiian Islands longline fishing prohibited area. The *Captain T&T* was fined $15,500, and $2,000 were seized from the proceeds of the catch. In November 1993, the US longline fishing vessel *Kilauea* was sighted fishing inside the main Hawaiian Islands longline fishing prohibited area. $15,000 were seized from the proceeds of the catch from the *Kilauea*.

During 1993, the NMFS Office of Enforcement opened twenty eight Western Pacific Pelagics investigations, which included four for fishing within the prohibited longline area surrounding the main Hawaiian Islands. Sixteen additional cases were investigated in Guam involving pelagic species. These involved foreign vessels in violation of the Magnuson Act and/or Lacey Act. Two investigations were opened in American Samoa involving foreign vessels.

NMFS agents located in Honolulu, Guam, and American Samoa spent over 4,000 man-hours in the investigation of alleged violations of the Pelagic Fisheries of the Western Pacific Region. Over 1,100 man-hours were expended in the investigation of Lacey Act violations involving the unlawful importation of pelagic species taken in violation of foreign law. Many of the investigations which occurred during 1993 involved the cooperative effort of the USCG as well as the state/territorial resource enforcement agencies.

The Pelagics FMP receives the highest Coast Guard enforcement activity level of any fishery management plan in the Western Pacific. In Coast Guard District 14, for the size of the domestic fisheries and potential threat to living marine resources, enforcement is believed to be adequate and compliance with FMP measures satisfactory at this time. The number of suspected violations and civil penalty actions have been reduced. However, in contrast to the domestic fishery, foreign fisheries enforcement has not had the resources in remote Western Pacific US

EEZs for surveillance missions. As a result, the relative scale of poaching or a volume of foreign fishing activity remains essentially unknown.

Due to an unusually low amount of search and rescue cases in 1993, the law enforcement branch was allocated approximately an additional 100 C-130 flight hours. The additional hours helped off set the living marine resources hours that were expended for the illegal alien case of the M/V *Eastwood*.

Habitat Issues

There is no information to suggest that the habitat of pelagic management unit species was subjected to major alterations in 1993. The continuing introduction of low-level pollution from diverse sources, however, combined with occasional pulses at higher levels, is an ongoing problem. Pollution sources include runoff from high islands, sewage from island outfalls and ships, oil from ship bilges and accidental spills, and marine debris origination from land or ships in the region, or drifting in from other areas.

On 14 October 1993, the Taiwanese longline fishing vessel *Jin Shiang Fa* ran aground on the reef along the western side of Rose Atoll, American Samoa. The vessel spilled an estimated 100,000 gallons of diesel fuel, 500 gallons of lube oil, and 2,500 pounds of ammonia. In November, NMFS participated in a multi-agency Natural Resource Damage Assessment of the atoll. Damage from spilled fuel products and physical damage from the vessel and gear was documented within the lagoon and on the outer atoll reef to a depth of 150 feet. A plume of oil extended from the wreck site out into the pelagic environment. Follow-up damage assessment will continue with reports submitted to the Council.

In 1993, the Marine Spill Response Corporation (MSRC) set up operations in Hawaii to respond to large oil spills in the Pacific islands. Their new top-of-the-line spill recovery vessel, the *Hawaiian Responder*, will be based in Honolulu Harbor. MSRC will handle spills greater than 1,250 bbls and the local co-op, Clean Islands Council, will handle the smaller spills with their smaller vessel.

The Council and NMFS continue to receive and review periodic reports of the ocean dumping of cannery waste from the two tuna canneries in Pago Pago, American Samoa. This dumping is authorized, however, under special permits from the US Environmental Protection Agency, and no significant adverse impacts have been noted.

The potential threat to pelagic habitat is reviewed through the Council's Ecosystems and Habitat Committee. The Council adopted a Habitat Policy that will assure that each fishery management plan includes all available information on habitat significance to the species to be managed.

American Samoa

Introduction

Pelagic fisheries resources in America Samoa have been an increasingly-important component of the domestic commercial fisheries since the early 1970s. Pago Pago Harbor on the island of Tutuila is a major base for the shipment and processing of foreign tuna. The pelagic fishery is monitored by the Department of Marine and Wildlife Resources (DMWR), through a program established in conjunction with the Western Pacific Fishery Information Network. Prior to 1985, only commercial landings were monitored. From October 1985 to the present, data were collected through a creel survey, accounting for subsistence and recreational pelagic fishing in addition to commercial landings. This report was prepared by DMWR using information that was derived from a statistically-designed survey of all pelagic fishing activities, excluding tournament catches, and partially fulfills the national standard requirement for a Stock Assessment and Fishery Evaluation (SAFE) report.

Summary

The pelagic fishery in American Samoa, which began in the early 1970s, continues to operate on a small scale. In 1993, 40 boats made an estimated 536 trips on which a pelagic fish was landed. The majority of the boats operated on a part-time basis, and most trips were one day in duration.

In general, American Samoa's pelagic fishery appears to be driven more by local economics and the effects of hurricanes than by species abundance and availability. In the early 1980s, the fishery prospered from rising prices and government assistance in the form of low interest loans for boat purchases and an active program to develop gear types and techniques applicable to local conditions.

Several devastating hurricanes have struck the territory in recent years: Tusi in January 1987, Ofa in February 1990, and Val in December 1991. The effects of these hurricanes are reflected in the amount of fishing effort expended. Notable decreases in effort occurred in 1987 and 1990, and corresponding drops in catch and revenue are evident. Although Hurricane Val was one of the most devastating hurricanes in recent memory, its effects are not visible in the catch data for 1992. Only three fewer boats fished pelagic species in 1992 than 1991, and there was a slight decrease in the number of fishing trips. There was a decrease in total catch and effort of most species in 1993, even though 48% more boats fished. This may be partially explained by the fact that unexpanded landings per boat show that 23% of the boats landed 72% of the catch, and another 20% of the boats landed less than 1% of the total catch. In general, since the large drop in landings in 1990, the fishery has remained at low levels. This is plausibly due to the onslaught of hurricanes; damaged commercial boats damaged not been repaired or replaced (so newer boats added to the fleet may be less-commercially oriented), and fishermen's priorities may have changed. In short, the fishery has not recovered and continues to fluctuate at low levels.

Prices paid for tunas have increased steadily in recent years, reaching record highs in 1991 and 1993 at approximately $1.50/lb. Prices for other PPMUS species continued to increase in 1993. Although prices have generally increased in recent years, the revenue per PPMUS trip has remained relatively steady, possibly due to fishermen making shorter trips, and thus catching fewer fish. From 1983 to 1987, trips averaged 8.7 hours, from 1988 to 1992 trips averaged 6.4 hours, and in 1993 the average trip duration was 5.6 hours.

The pelagic fishery faces some competition from a supply of frozen fish purchased or bartered from foreign longline vessels moored in Pago Pago Harbor. In some cases, Samoan fishermen act as middlemen in the transactions between longliners and the market. Poor documentation of these transactions makes it difficult to determine the magnitude of these imports and to assess their impact on the market for fresh fish supplied by local fishermen.

Imports of pelagic fish through regular channels are not currently an important source of competition with the local fishery. The market share of imported pelagic species declined from 66% in 1990 to 20% in 1991, and only 3% in 1992 and 1993. The undocumented imports from foreign longliners may have supplanted these imports.

Recommendations

1) Continue efforts to monitor the pelagic fisheries of the local fleet in American Samoa.

2) Incorporate distances travelled to fishing grounds by local fleet into the annual report, particularly regarding interpretations concerning hours per trip.

3) Quantify the amount of exchange between local fishermen and foreign longline vessels, and their impact on the market for regular imports and local fresh fish landings.

4) Improve local stock assessment by incorporating information (total landings and economic information) from the two canneries located on Tutuila.

Tables

page

1. American Samoa 1993 total landings of pelagic species 1-4
2. American Samoa 1993 commercial landings, value and average price of pelagic species . 1-5

Figures

page

1. American Samoa total annual landings -- all pelagics, tuna and other PPMUS 1-6
2. American Samoa total annual landings -- mahimahi and wahoo 1-8
3. American Samoa annual landings -- blue marlin and sailfish 1-9
4. American Samoa total annual landings -- skipjack and yellowfin tuna 1-10
5. American Samoa annual commercial landings -- all pelagics and other PPMUS 1-11
6. Number of American Samoa boats landing any pelagics, tunas and other PPMUS 1-12
7. American Samoa annual effective fishing effort (trolling only) for pelagic species 1-13
8. American Samoa annual inflation-adjusted revenues for commercial landings of pelagic species 1-15
9. American Samoa average price of tunas and other PPMUS 1-17
10. American Samoa trolling catch rates -- blue marlin, mahimahi and wahoo 1-18
11. American Samoa trolling catch rates -- skipjack and yellowfin tuna 1-19
12. American Samoa pelagic catch per hour trolling 1-20
13. American Samoa average inflation-adjusted revenue per trip landing PPMUS 1-22

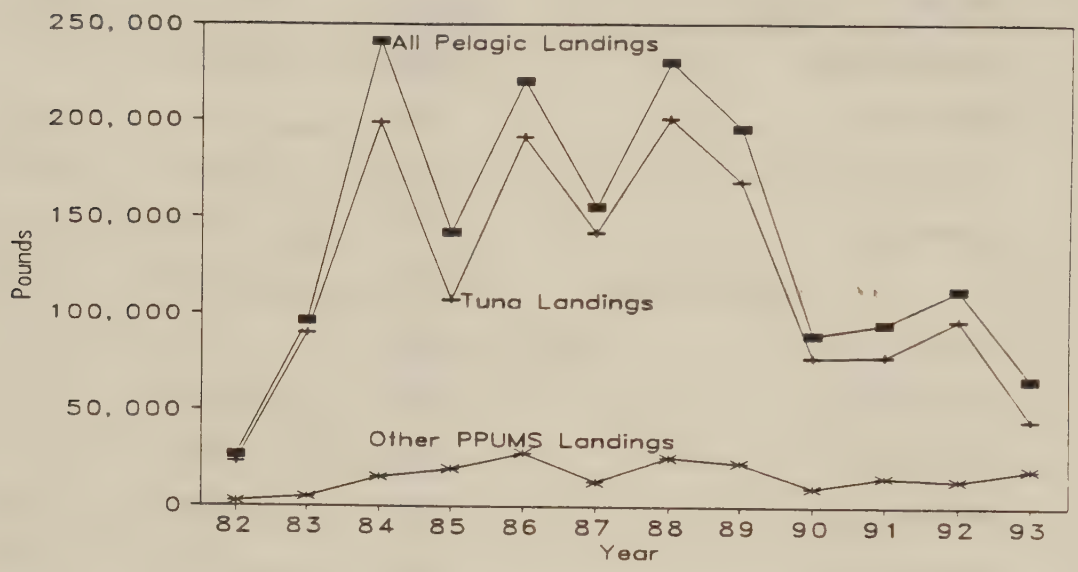
Table 1. American Samoa 1993 total landings of pelagic species

Species	Pounds
Skipjack Tuna	25,720
Albacore	199
Yellowfin Tuna	18,989
Kawakawa	88
Bigeye Tuna	86
Subtotal Tunas	**45,082**
Mahimahi	4,834
Blue Marlin	7,599
Wahoo	3,083
Dogtooth Tuna	1,924
Sharks	576
Sailfish	1,037
Subtotal other PPMUS	**19,053**
Barracuda	1,691
Rainbow Runner	67
Subtotal Misc.	**1,758**
All Pelagics	**65,893**

Table 2. American Samoa 1993 commercial landings, value and average price of pelagic species

Species	Pounds	Value ($)	$/lb
Skipjack Tuna	24,690	29,529	1.20
Albacore	199	199	1.00
Yellowfin Tuna	16,706	32,685	1.96
Kawakawa	89	168	1.90
Subtotal Tunas	**41,684**	**62,581**	**1.51**
Sharks	245	450	1.84
Mahimahi	3,823	9,896	2.59
Blue Marlin	4,113	7,197	1.75
Wahoo	2,344	5,295	2.26
Dogtooth Tuna	1,931	3,276	1.70
Sailfish	258	451	1.75
Subtotal other PPMUS	**12,714**	**26,565**	**1.98**
Barracuda	1,616	2,570	1.59
Rainbow Runner	72	181	2.50
Subtotal Misc.	**1,688**	**2,751**	**2.05**
All Pelagics	**56,084**	**91,897**	**1.64**

Figure 1. American Samoa total annual landings -- all pelagics, tuna and other PPMUS



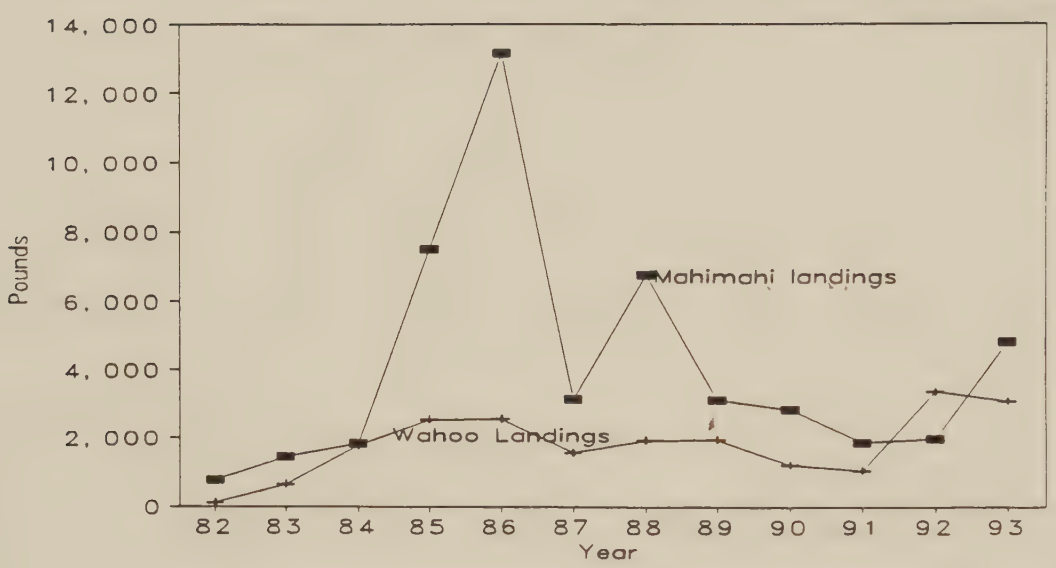
Year	Pounds Landed		
	All Pelagics	Tuna	Other PPMUS
1982	26,396	23,042	2,106
1983	96,318	90,057	4,806
1984	241,099	198,961	15,121
1985	142,570	107,453	19,262
1986	220,571	191,596	27,416
1987	155,324	142,319	12,613
1988	230,516	200,785	25,439
1989	195,728	168,325	22,705
1990	89,322	77,626	9,804
1991	95,020	78,225	14,942
1992	112,431	96,797	13,437
1993	65,893	45,082	19,053

Calculation: Tuna and Other PPMUS subtotals were obtained by summing the species landings in each category, and the All Pelagics value represents the sum of these subtotals plus the Miscellaneous category (see Table 1). These values include both commercial and recreational/subsistence components of the fishery.

Interpretation: Although pelagics landings have in general been variable, 1990-93 landing levels were notably low. The 1990-92 declines could be partially due to reduced fishing effort after Hurricane Ofa hit in February 1990, and hurricane Val in 1991. It is not clear why there was a 41% decline in total pelagic landings in 1993 from 1992.

Tunas have been the main component of the total pelagic landings, comprising approximately 85% of the catch in most years, though in 1993 that proportion decreased to 68%. There was a 53% decline in tuna landings from 1992 to 1993. The small-scale (and thus inherently variable) nature of this fishery makes it difficult to interpret a decline such as this in terms of classical fisheries analysis.

Figure 2. American Samoa total annual landings -- mahimahi and wahoo



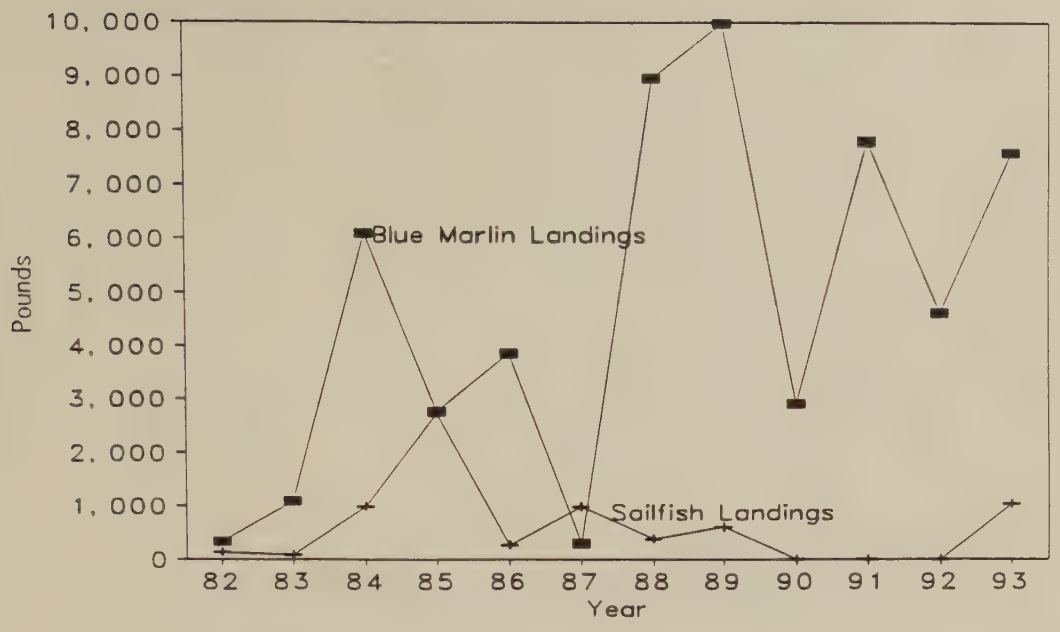
	Pounds Landed	
Year	Mahimahi	Wahoo
1982	777	114
1983	1,443	632
1984	1,844	1,777
1985	7,528	2,535
1986	13,160	2,564
1987	3,136	1,563
1988	6,791	1,929
1989	3,120	1,959
1990	2,833	1,225
1991	1,859	1,048
1992	1,987	3,381
1993	4,834	3,083

Calculation: The estimated total landings for mahimahi and wahoo were summed for all fishing methods.

Interpretation: Mahimahi landings have been variable through time, though the reasons for this variability are unknown. Similar fluctuations have occurred in each of the region's island groups. From 1984-88, when American Samoan fishermen exported mahimahi to Hawaii, the three highest annual landings occurred. The 1993 landings are the largest since the end of this export period.

Wahoo landings were relatively stable, and in general contribute a lesser amount than mahimahi to the total catch. Wahoo landings reached a record high in 1992 and remained high in 1993.

Figure 3. American Samoa annual landings -- blue marlin and sailfish

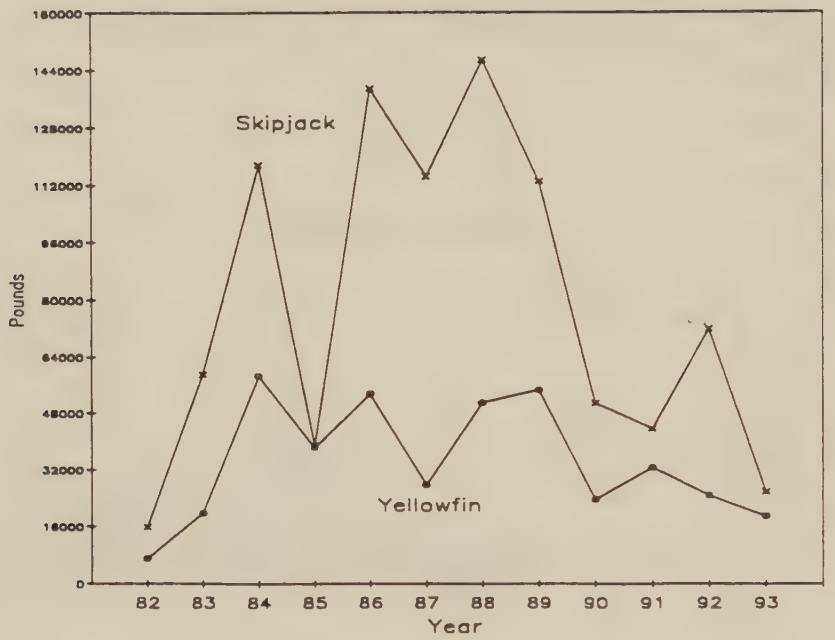


	Pounds Landed	
Year	**Blue Marlin**	**Sailfish**
1982	315	127
1983	1,083	74
1984	6,097	989
1985	2,778	2,744
1986	3,871	259
1987	297	986
1988	8,959	367
1989	9,969	597
1990	2,922	0
1991	7,804	0
1992	4,628	0
1993	7,599	1,037

Calculation: The estimated total yearly landings of blue marlin and sailfish were summed for all fishing methods.

Interpretation: Landings of both blue marlin and sailfish have been historically variable. Local commercial fishermen rarely target billfishes because of their lower CPUE relative to tuna and, in some cases, the difficulty of storage and preservation of these large fish while at sea.

Figure 4. American Samoa total annual landings -- skipjack and yellowfin tuna

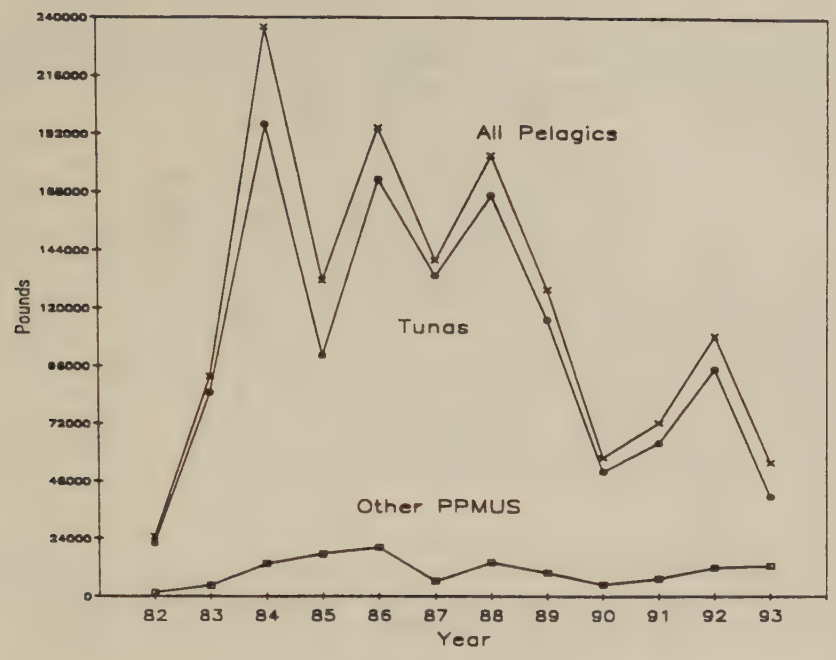


	Pounds Landed	
Year	Skipjack Tuna	Yellowfin Tuna
1982	15,877	7,038
1983	58,997	19,789
1984	117,693	58,704
1985	38,939	38,343
1986	138,826	52,662
1987	114,406	27,767
1988	146,874	51,022
1989	112,987	54,666
1990	50,877	23,635
1991	43,662	32,643
1992	71,930	24,684
1993	25,720	18,989

Calculation: The estimated yearly total landings of skipjack and yellowfin tuna were summed for all fishing methods.

Interpretation: The decreased landings seen from 1990-93 for yellowfin tuna could partially be due to decreased effort as CPUE for yellowfin has remained stable. The CPUE for skipjack actually increased in 1992, though there was a decrease in 1993 (Figure 11). Some fishermen say that this could be due to the increased distance they must travel to capture the fish, thus increasing the time per trip without a concurrent increase in catch. Skipjack and yellowfin tuna were the two main contributors to total pelagic landings (see Table 1).

Figure 5. American Samoa annual commercial landings -- all pelagics and other PPMUS

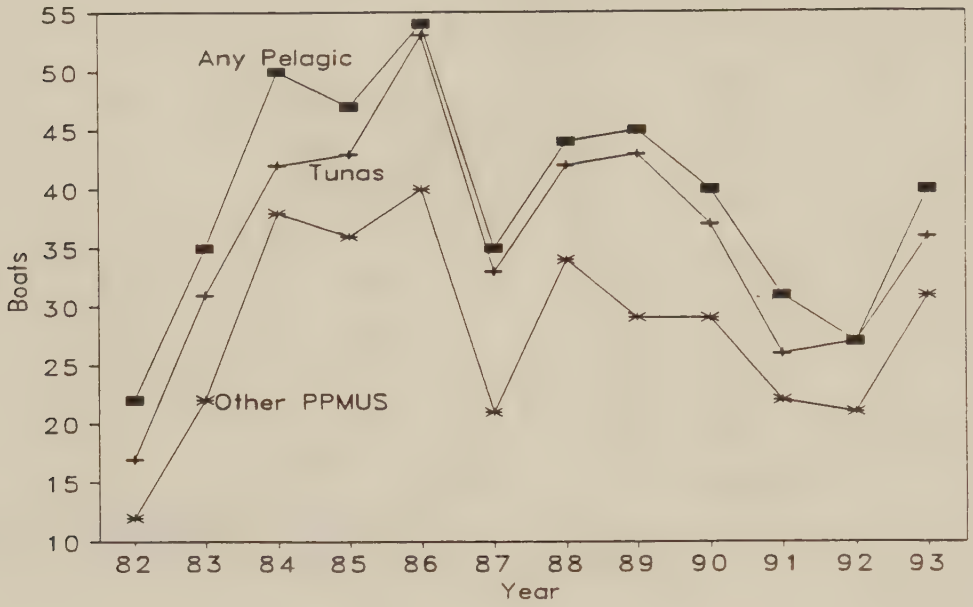


Year	Pounds Landed		
	All Pelagics	Tunas	Other PPMUS
1982	24,820	22,065	1,515
1983	90,744	85,069	4,441
1984	236,216	196,100	13,458
1985	131,623	100,373	17,448
1986	194,717	173,374	20,278
1987	140,031	133,594	6,236
1988	183,379	166,915	14,062
1989	128,096	115,485	9,731
1990	57,907	51,995	4,858
1991	72,664	64,037	7,318
1992	108,940	95,051	11,809
1993	56,084	41,683	12,713

Calculation: The total yearly estimated pounds of all the pelagic species, tunas only, and other PPMUS only were summed for all methods of fishing, exclusively for fishes that were sold.

Interpretation: The decrease in commercial pelagic landings in 1990 and 1991 was due primarily to decreases in tuna landings (see also Fig. 4). The 48% decrease in commercial landings of all pelagic species in 1993 might partially be explained by an overall decrease in fishing effort. There was a 48% decrease in trips per boat this year (Figs. 6 and 7), and unexpanded total landings per boat show that 23% of the boats landed 72% of the total catch. Another 20% of the boats landed less than 1% of the total catch.

Figure 6. Number of American Samoa boats landing any pelagics, tunas and other PPMUS

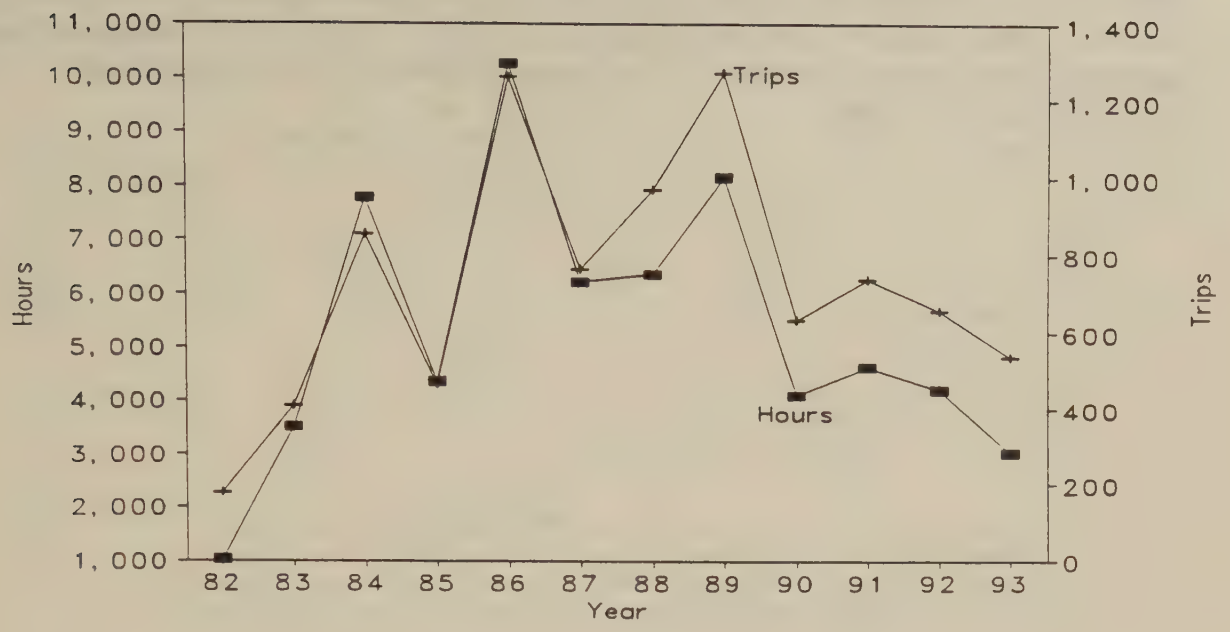


	Number of Boats landing:		
Year	Any Pelagic	Tunas	Other PPMUS
1982	22	17	12
1983	35	31	22
1984	50	42	38
1985	47	43	36
1986	54	53	40
1987	35	33	21
1988	44	42	34
1989	45	43	29
1990	40	37	29
1991	31	26	22
1992	27	27	21
1993	40	36	31

Calculation: The sampling program was extensive enough, and the number of boats small enough, to use the raw database counts of the number of unique vessels in a given year. When the data were collected, the vessel was always identified. Each of the boats counted in the above table made at least one recorded landing of at least one pelagic species during a given year.

Interpretation: After peaking in 1986, the number of boats in the fishery declined as boats fell into disrepair, were damaged by hurricanes, or the fishermen left the fishery for other reasons. The increase in number of boats fishing in 1993 (48% increase over 1992), however, does not evidently indicate that fishing effort increased while landings declined. As noted in the interpretation for Fig. 5, 23% of these boats made 72% of the landings, and an additional 20% of the boats landed less than 1% of the fish.

Figure 7. American Samoa annual effective fishing effort (trolling only) for pelagic species

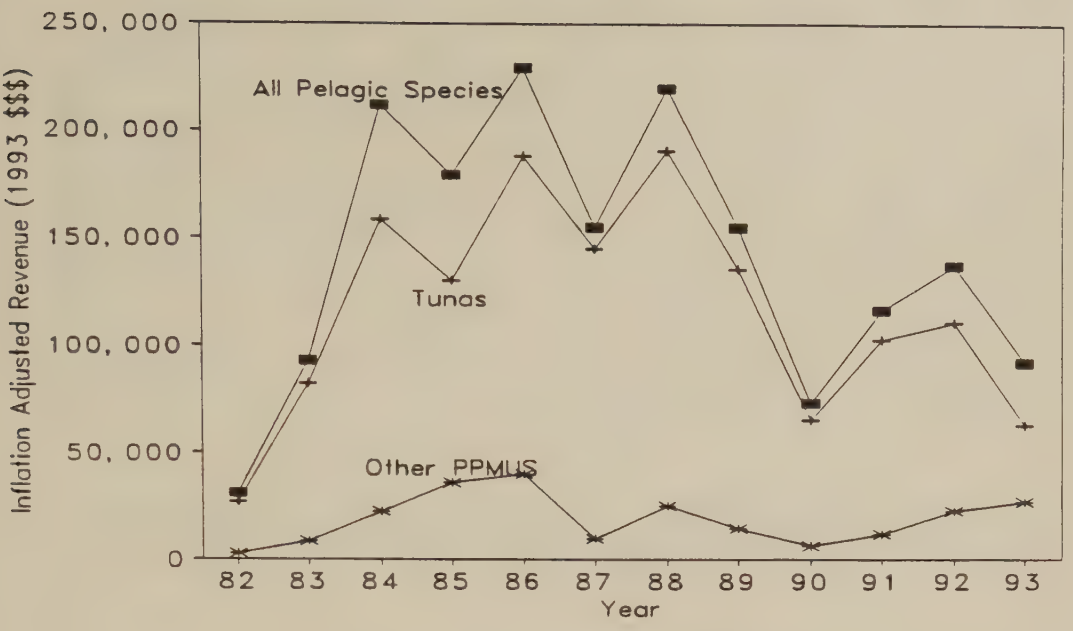


	Estimated Trolling Effort	
Year	Hours	Trips
1982	1,019	177
1983	3,513	406
1984	7,785	853
1985	4,375	462
1986	10,263	1,262
1987	6,218	764
1988	6,372	969
1989	8,153	1,271
1990	4,120	634
1991	4,656	739
1992	4,212	657
1993	3,020	536

Calculation: The estimated total annual landings of all pelagic species was used as a base for calculating the estimated number of trips and hours spent fishing for pelagic species by vessels using trolling methods only. The estimated total longliner landings were subtracted from the total pelagic landings, and the resultant number was divided by the average catch per hour (CPUE) for the trolling method to give an estimate of the hours trolled. The CPUE was calculated using only those trips which trolled exclusively and for which the number of hours was recorded. The number of trips was calculated by dividing the estimated annual number of hours by the average length of a trolling trip.

Interpretation: The amount of effort expended to catch pelagic species has been variable, owing largely to the fluctuation in the number of boats in the fleet making pelagic landings (see Fig. 6). Thus, the fleet expanded and fishing effort generally increased since 1982, but suffered major setbacks in 1987 and 1990, presumably due to hurricanes. However, the average trip length has decreased from 8.7 hours in 1983-87, to 6.7 hours in 1988-92, to 5.6 hours in 1993. The cause of this decrease is not clear.

Figure 8. American Samoa annual inflation-adjusted revenues for commercial landings of pelagic species



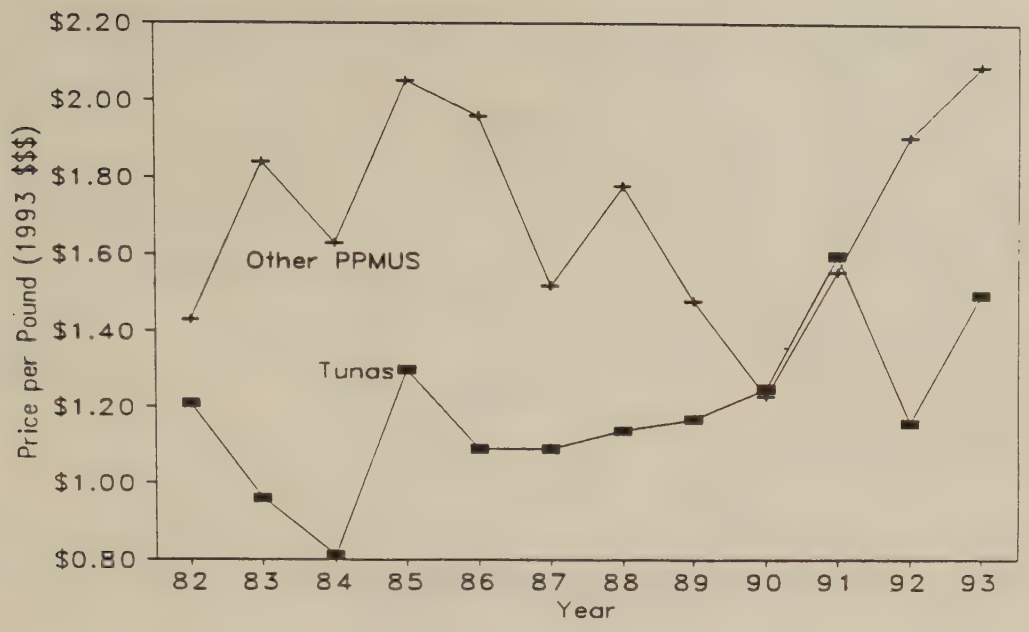
	Revenue ($)					
	All Pelagics		Tunas		Other PPMUS	
Year	Unadjust.	Adjusted	Unadjust.	Adjusted	Unadjust.	Adjusted
1982	21,824	30,772	18,990	26,776	1,534	2,163
1983	66,254	92,756	58,561	81,985	5,828	8,159
1984	153,571	211,928	114,981	158,674	15,938	21,994
1985	131,905	179,391	95,610	130,030	26,305	35,775
1986	173,795	229,410	142,620	188,259	30,132	39,774
1987	123,083	155,085	115,269	145,238	7,539	9,499
1988	178,931	220,085	155,234	190,938	20,353	25,034
1989	131,303	154,938	114,941	135,630	12,175	14,366
1990	66,872	72,890	59,839	65,224	5,504	5,999
1991	110,894	116,439	97,824	102,715	10,867	11,410
1992	137,016	137,016	110,648	110,648	22,513	22,513
1993	91,897	91,897	62,581	62,581	26,565	26,565

Calculation: Revenues from commercial landings for all pelagic species and PPMUS (see Fig. 5) were adjusted for inflation by multiplying a given year's revenue by the quotient of the 1993 consumer price index (CPI) divided by the CPI for that year.

Interpretation: The sharp decline in 1990 revenues was the combined result of reduced prices and landings. Total pelagic revenues improved in 1991 and 1992, primarily due to increased

prices of tuna. In 1993, however, revenues for all pelagics decreased again to 1990 levels even though the average price of tuna increased. Since there was a slight increase in revenues for "other PPMUS", it is probable that the fluctuations seen here had more to do with landings than with prices.

Figure 9. American Samoa average price of tunas and other PPMUS

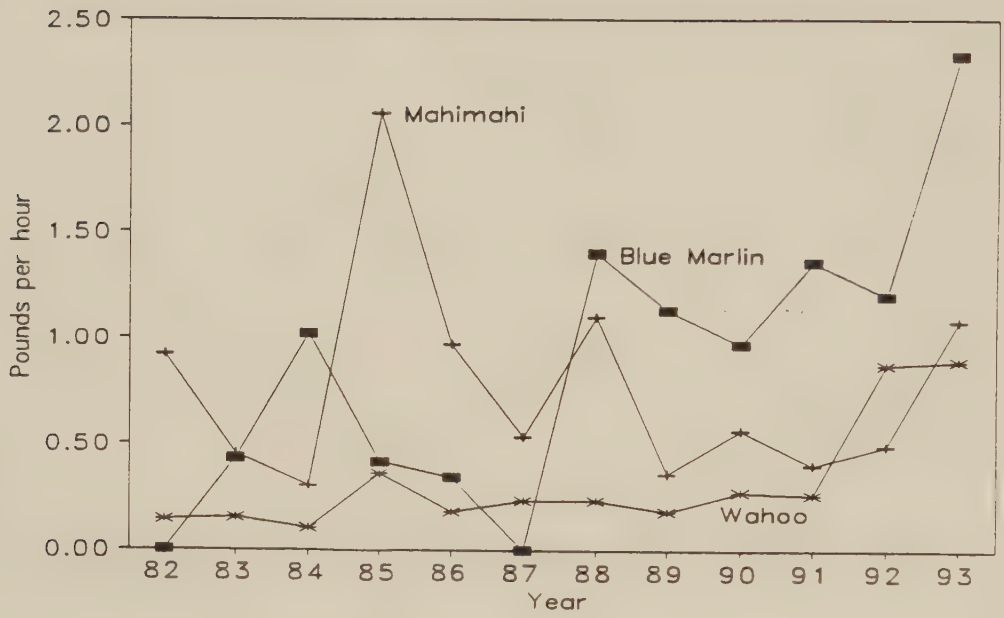


	Average Price ($/lb)			
	Tunas		Other PPMUS	
Year	Unadjust.	Adjusted	Unadjust.	Adjusted
1982	0.86	1.21	1.01	1.43
1983	0.69	0.96	1.31	1.84
1984	0.59	0.81	1.18	1.63
1985	0.95	1.30	1.51	2.05
1986	0.82	1.09	1.49	1.96
1987	0.86	1.09	1.21	1.52
1988	0.93	1.14	1.45	1.78
1989	1.00	1.17	1.25	1.48
1990	1.15	1.25	1.13	1.23
1991	1.53	1.60	1.48	1.56
1992	1.16	1.16	1.91	1.91
1993	1.50	1.50	2.09	2.09

Calculation: The average PPMUS price for each year was calculated by dividing the estimated revenue by the estimated weight sold. The adjustment for inflation was made by multiplying the annual average price for a given year by the 1993 consumer price index (CPI) for American Samoa and dividing by the CPI for the given year.

Interpretation: Record high prices for tunas were received in 1991 and 1993. Prices paid for other PPMUS species recovered from a record low in 1990 to peak levels in 1993.

Figure 10. American Samoa trolling catch rates -- blue marlin, mahimahi and wahoo

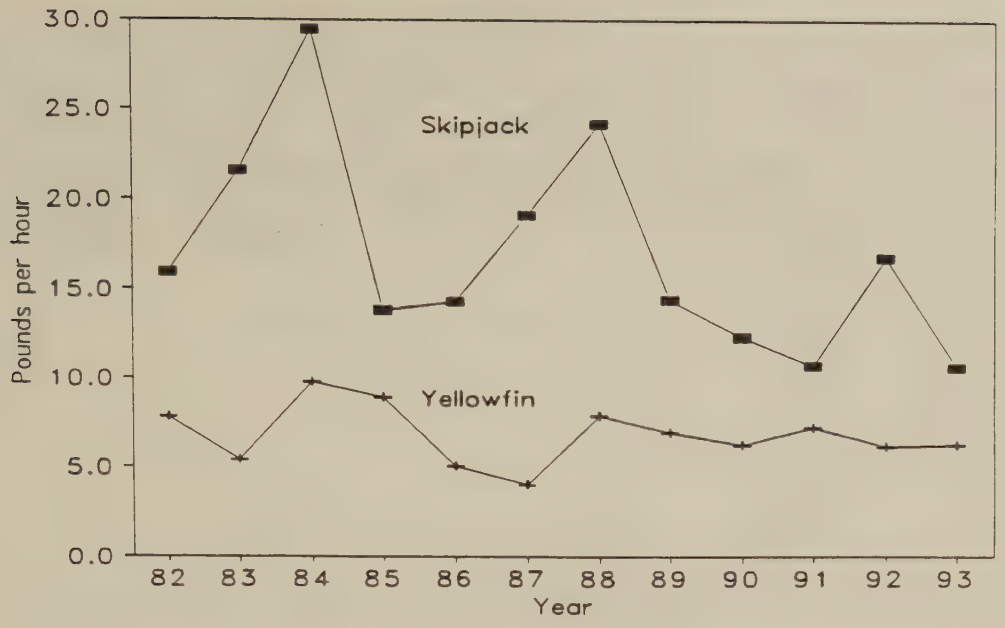


Year	Pounds Caught per Hour Trolling		
	Blue Marlin	Mahimahi	Wahoo
1982	0	0.92	0.14
1983	0.43	0.45	0.15
1984	1.02	0.30	0.10
1985	0.41	2.06	0.36
1986	0.34	0.97	0.18
1987	0	0.53	0.23
1988	1.40	1.10	0.23
1989	1.13	0.36	0.18
1990	0.97	0.56	0.27
1991	1.36	0.40	0.26
1992	1.20	0.49	0.87
1993	2.33	1.08	0.89

Calculation: For trips that used the trolling method exclusively and where effort was recorded in hours, the sum of the individual species landings was divided by the sum of trolling hours to obtain CPUE.

Interpretation: CPUE for these species was variable. Wahoo CPUE reached an all time high in 1993, and the blue marlin CPUE was 66% higher than the highest recorded CPUE for this species (in 1988). Except for an unusually high catch rate in 1985, mahimahi catch rates have fluctuated around an average of 0.65. Record catch rates for blue marlin and wahoo were recorded in 1993. Blue marlin catch rates were notably higher in 1988-92 than in previous years, and in 1993 was three times the previous 11-year average of 0.76. Wahoo CPUE increased three-fold in 1992 over previous levels, and increased again slightly in 1993.

Figure 11. American Samoa trolling catch rates -- skipjack and yellowfin tuna

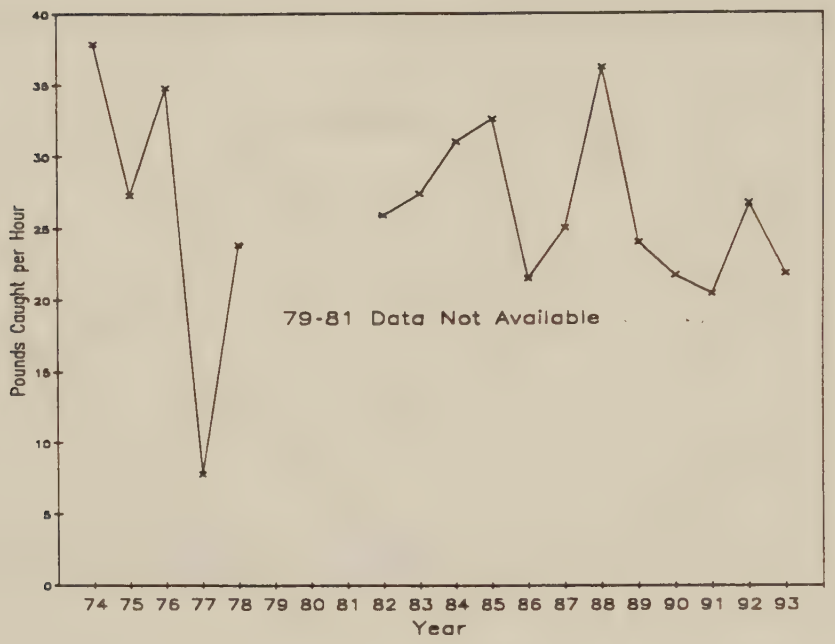


	Pounds Caught Per Hour Trolling	
Year	**Skipjack**	**Yellowfin**
1982	15.90	7.80
1983	21.60	5.40
1984	29.50	9.74
1985	13.80	8.90
1986	14.30	5.05
1987	19.10	3.98
1988	24.20	7.85
1989	14.40	6.94
1990	12.30	6.23
1991	10.70	7.23
1992	16.70	6.12
1993	10.60	6.23

Calculation: For trips that employed the trolling method exclusively and where effort was recorded in hours, the sum of the individual species catch was divided by the sum of trolling hours to obtain CPUE.

Interpretation: While skipjack tuna CPUE has been variable through the years, a declining trend is apparent. Catch rates for yellowfin tuna have remained relatively constant in recent years.

Figure 12. American Samoa pelagic catch per hour trolling



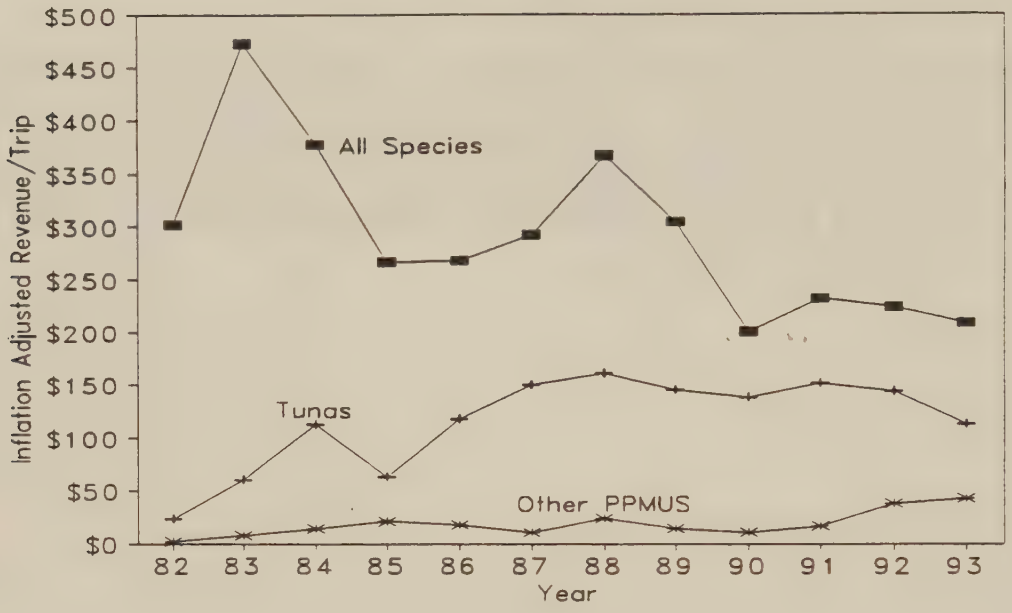
Year	Pounds Caught per Hour	Trips	Data Source
1974	37.90	31	
1975	27.30	98	
1976	34.80	10	Dory Project
1977	7.80	6	
1978	23.90	96	
1982	25.91	104	
1983	27.41	156	Commercial Catch Monitoring
1984	30.97	311	
1985	32.59	193	
1986	21.49	401	
1987	24.98	217	
1988	36.17	281	
1989	24.01	372	Creel Census
1990	21.68	288	
1991	20.41	211	
1992	26.69	206	
1993	21.82	216	

Calculation: For trips using only trolling gear and where number of hours fished were recorded the CPUE (pounds per hour) was summed and divided by the number of trips to get a mean CPUE. Data are from three sources; 1974-78 are from the Dory Project, 1982-84 are from the commercial catch monitoring system, and 1985-93 are from the creel survey program.

Interpretation: Total pelagic species CPUE was predominantly the combined skipjack and yellowfin CPUE shown in Figure 11, as these two species contribute close to 85% of the total catch.

Pelagic species CPUE was variable, especially in the early years of the American Samoa troll fishery. The low CPUE in 1977 was possibly an artifact of the low number of observations or other data collection problems. A factor which probably affected the 1990, 1991 and 1992 CPUE was that all but one of the fish aggregation devices (FADs) surrounding Tutuila were lost shortly after Hurricane Ofa in February 1990, and the remaining FAD was lost in March of 1992. Plans to replace the FADs are pending.

Figure 13. American Samoa average inflation-adjusted revenue per trip landing PPMUS



	Revenue per PPMUS trip ($)					
	All Species		Tuna		Other PPMUS	
Year	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
1982	214	302	16	23	1	2
1983	338	473	43	60	5	7
1984	274	378	82	113	11	14
1985	196	267	47	63	16	21
1986	203	268	90	118	14	18
1987	232	292	119	150	8	10
1988	299	367	131	161	19	24
1989	258	304	123	145	12	14
1990	184	200	126	138	9	10
1991	220	231	144	151	15	16
1992	223	223	144	144	38	38
1993	208	208	112	112	43	43

Calculation: For each trip that landed any PPMUS (excluding longline trips), and which sold at least a portion of their catch, the average PPMUS revenue per trip and average total pelagic species revenue per trip was calculated. The revenues were adjusted for inflation by multiplying them by the quotient of the 1993 CPI divided by the respective years' CPI.

Interpretation: Revenue per trip for all species combined fell to a nine-year low in 1990 and have remained at about the same level through 1993. The revenue per trip for Tunas remained nearly constant for the past five years, until a slight drop in 1993. This drop coincided with a slight increase in revenue of Other PPMUS.

Appendix 2

Guam

Introduction and Summary

Pelagic fishing vessels based in Guam fall into two broad categories: 1) distant-water purse seiners and longliners that fish primarily outside the EEZ and transship through Guam, and 2) small, primarily-recreational trolling boats that are either towed to launch sites or berthed in marinas and fish only within the Guam EEZ or occasionally in the adjacent EEZ of the Northern Mariana Islands. This report covers only the local small-boat pelagics fishery.

During the past 14 years, the estimated number of vessels participating in the fishery has steadily increased from about 115 to 309. Presently, most vessels are under ten meters in length and are typically owner-operated by people who earn a living outside of fishing. However, almost everyone sells a portion of their catch at one time or another, and it is impossible to make a distinction between recreational, subsistence, or commercial fishermen. A small but rapidly-growing segment of the fleet consists of marina-berthed charter vessels that are operated primarily by full-time captains and crews.

Estimated annual landings have varied widely, ranging between 175 and 429 tons. Landings consist almost entirely of five major species: mahimahi (*Coryphaena hippurus*), wahoo (*Acanthocybium solandri*), skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*), and Indo-Pacific blue marlin (*Makaira mazara*). Minor components include rainbow runner (*Elagatis bipinnulatus*), great barracuda (*Sphyraena barracuda*), kawakawa (*Euthynnus affinis*), dogtooth tuna (*Gymnosarda unicolor*), sailfish (*Istiophorus platypterus*), and shortbill spearfish (*Tetrapterus angustirostris*). Approximately a dozen additional species are landed incidentally each year.

There are wide inter-annual fluctuations in the catches of mahimahi, wahoo, and tunas. However, annual landings of yellowfin tuna appear to have declined from 1982 to 1989, recovered by 1992, but declined during the past year. Annual landings of blue marlin increased sharply from 1980 to a three-year plateau in 1990-92, followed by a decline during the past year.

Aggregate landings of non-tuna PPMUS appear to be increasing, while those of tunas show no general trend. In the early 1980s, the bulk of the catch consisted of tunas, but since 1985 it has consisted of non-tuna or "other" PPMUS, with mahimahi usually the most important species. Commercial landings of all pelagics has increased steadily over the past 14 years with all of the increase in the non-tuna PPMUS segment.

Effort in terms of hours and trips has increased since 1983, while hours spent per trip has decreased. This is a reflection of a decline of full-time commercial sector of the fishery, and an increase in the charter sector, which generally makes half-day rather than full-day trips.

Inflation-adjusted revenues for all pelagic species, tunas and other PPMUS have decreased slightly from peaks during 1983-84, while inflation-adjusted revenue per trip for all pelagic species, tunas and other PPMUS have sharply decreased over the past 10 years.

Annual trolling catch rates have varied widely for all species. The recent period of increase in the catch rate of blue marlin was probably due to a concurrent increase in the charterboat segment which operates larger vessels more capable of targeting this species. The average size and the size of the winning fish for yellowfin tuna caught in the Guam International Fishing Derby also decreased from 1978-89 and 1979-1989, respectively, but have fluctuated widely since then. Decreases in the catch rates and size of yellowfin tuna may be a result of adverse impacts on the regional stocks or local availability by neighboring longline or purse seine fisheries.

Inflation-adjusted prices have steadily declined since 1980. The difficulty of obtaining a consistent supply of fresh fish from local fishermen has forced many marketers to turn to other sources, at least part of the time. Some hotels import higher-priced tuna from Japan to meet their demand for sashimi. There is a widespread belief among local fishermen that the flooding of local markets with inexpensive foreign-caught fish in recent years has depressed their ex-vessel prices. There is also evidence that a considerable quantity of low-cost "grade B" yellowfin tuna, usually destined for surface transshipment, enters the local economy illegally.

There were no longliners, domestic or foreign licensed to fish within Guam's EEZ during 1993. Guam Department of Commerce reported that during 1993, 270 foreign longliners made 1,069 port calls and transshipped 7,831 tons of fish through Guam. This included 4,071 tons of bigeye tuna (52%), 3,380 tons of yellowfin tuna (43%), 183 tons of blue marlin (2%), and 191 tons of black marlin, striped marlin, swordfish, and others (3%). All of this was allegedly caught outside of Guam's EEZ, but the extent of unauthorized longlining activity within the Guam EEZ is unknown.

Recommendations

1) A program to collect foreign longline vessel data logbooks in Guam should be initiated. All foreign longline vessels fishing, transshipping, or home ported in Guam should be required to submit a daily catch logbook as well as landings and transshipment reports to the Government of Guam and NMFS. A plan should be formulated in order to establish which Government of Guam or NMFS agencies will be responsible for the collection and processing of these data as well as enforcement of this requirement. Although most if not all foreign longline vessels may not be licensed to fish within the Guam EEZ, their fishing activities in adjacent EEZs impact the stocks of pelagic species migrating through the Guam EEZ. Since there is no mechanism available to compel the governments of the Federated States of Micronesia (FSM), Republic of Belau, or the Republic of the Marshall Islands to collect this data or to provide it to the Plan Team, it is necessary for the Team to obtain it by direct means. This should be a Federal as well as Government of Guam requirement, and enforcement should be a Federal as well as Government of Guam responsibility. All costs of this program and its enforcement should be born by the foreign fishing fleet. Therefore, a fee and permit system to allow the longline fleet to access Guam port facilities should be implemented. All fees collected should be dedicated to this program.

2) With the inclusion of tuna under the Magnuson Act, it is imperative that catch, effort, and biological data from the domestic and foreign purse-seine fisheries be made available to the PT. Regulations requiring a Federal purse-seine fishing permit, a landings report, a transshipment report, and a daily catch logbook report for all domestic purse-seine vessels fishing, transshipping, or home ported anywhere in the western Pacific Region should be established. These reports should cover all PPMUS whether incidental or targeted. The same regulations should be established for any foreign purse-seine vessel fishing, transshipping, or home ported in any territory or EEZ governed by the Council. Logbook data are necessary for effective management of this fishery as well as for defining overfishing as required by the revised National Standards. It is critical that a significant enforcement effort be applied to ensure compliance with permit and reporting requirements by all vessels. Compliance and general support among the fishermen would be enhanced if reporting procedures are designed to fulfill both State/Territory and Federal requirements.

3) All data from the purse seine and longline fisheries of the western Pacific pertaining to the bycatch of mahimahi, wahoo, and billfishes should be compiled and summarized. An attempt to assess the stocks of these species should be made utilizing data from all available sources. Any purse seine or longline vessel fishing, transshipping, or home ported in any territory or EEZ governed by the Council should be required to maintain logbook data on these species and provide it to the appropriate federal or local authorities.

4) Support should continue to be supplied to or by the island fisheries offices for collecting data on their pelagic fisheries, including the volume of landings, revenue of sales, fishing effort, and size composition of catch.

5) Future annual reports should include a discussion of the impacts of the Guam-based distant-water fleets on the local fisheries market. Particular attention should be given to assessing and quantifying the leakage of fish caught by these fleets into the local economy.

Tables

page

1. Guam 1993 creel survey -- pelagic species composition 2-5
2. Guam 1993 annual commercial average price of pelagic species 2-6

Figures

page

1. Guam annual estimated total landings -- all pelagics, other PPMUS, and tunas 2-7
2. Guam annual estimated total landings -- mahimahi and wahoo 2-9
3. Guam annual estimated total landings -- blue marlin and sailfish 2-11
4. Guam annual estimated total landings -- skipjack and yellowfin tunas 2-13
5. Guam annual estimated commercial landings -- all pelagics, tunas, and other PPMUS . . 2-14
6. Guam estimated number of trolling boats 2-16
7. Guam annual estimated pelagic species trips, hours, and hours per trip for trolling 2-18
8. Guam annual estimated commercial inflation-adjusted total revenues -- all pelagics, tunas, and other PPMUS 2-20
9. Guam average inflation-adjusted price of tunas and other PPMUS 2-22
10. Guam trolling catch rates -- mahimahi, wahoo, and blue marlin 2-24
11. Guam trolling catch rates -- skipjack and yellowfin tunas 2-26
12. Guam inflation-adjusted revenues per trolling trip landing tunas or other PPMUS 2-28
13. Guam International Fishing Derby average size and size of winning fish -- wahoo 2-30
14. Guam International Fishing Derby average size and size of winning fish -- yellowfin tuna 2-32
15. Guam International Fishing Derby average size and size of winning fish -- blue marlin 2-34

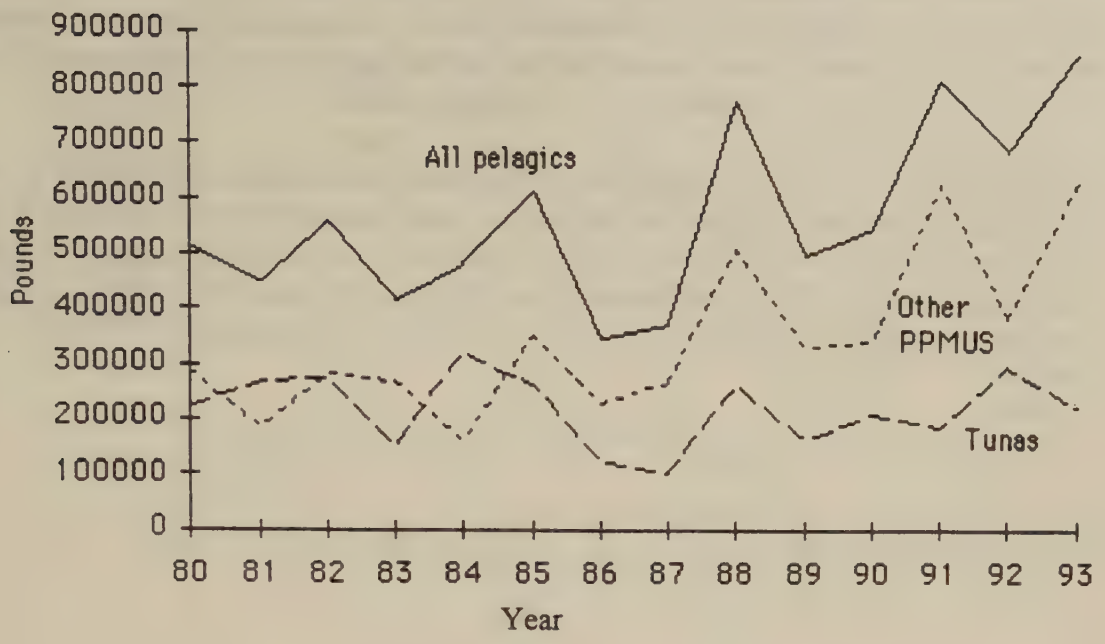
Table 1. Guam 1993 creel survey -- pelagic species composition

Species	Pounds Landed
Sharks	902
Mahimahi	423,988
Wahoo	97,448
Blue Marlin	98,698
Striped Marlin	0
Sailfish	2,379
Spearfish	469
Dogtooth Tuna	3,024
Subtotal Non-tuna PPMUS	**626,907**
Skipjack Tuna	135,163
Yellowfin Tuna	76,285
Bigeye Tuna	12,222
Kawakawa	962
Tunas (misc.)	24
Subtotal Tunas	**224,656**
Rainbow Runner	3,859
Barracudas	3,522
Subtotal Misc.	**7,381**
All Pelagics	**858,944**

Table 2. Guam 1993 annual commercial average price of pelagic species

Species	Average Price ($/lb)
Mahimahi	1.43
Wahoo	1.96
Marlin	0.99
Spearfish	1.34
Sailfish	1.13
Average Non-tuna PPMUS	**1.45**
Skipjack Tuna	1.20
Dogtooth Tuna	1.93
Yellowfin Tuna	2.25
Kawakawa	2.00
Average Tunas	**1.82**
Troll fish	2.00
Rainbow Runner	2.18
Barracuda	1.92
Average All Pelagics	**1.56**

Figure 1. Guam annual estimated total landings -- all pelagics, other PPMUS, and tunas



Year	Pounds Landed		
	All Pelagics	Other PPMUS	Tunas
1980	515,631	290,703	224,928
1981	450,813	183,549	267,264
1982	560,046	284,195	275,851
1983	418,222	267,117	151,106
1984	479,134	157,991	321,143
1985	614,520	352,649	261,872
1986	347,673	227,130	120,543
1987	370,586	268,068	102,519
1988	776,336	510,551	265,785
1989	501,880	334,857	167,024
1990	549,944	341,785	208,159
1991	814,786	627,398	187,388
1992	685,513	388,634	296,833
1993	858,944	626,907	224,656

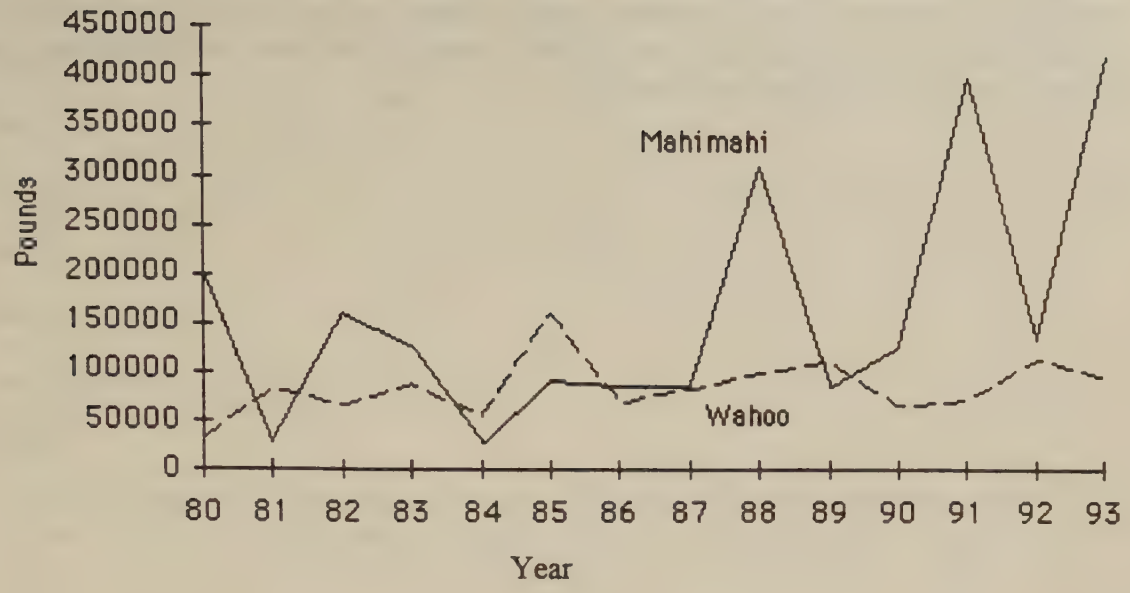
Source: The Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program and its associated computerized data expansion system files. The Guam Offshore Expansion System (GOES) and its algorithms are detailed in NMFS Admin. Rep. H-83-21C. For 1992-93, the GOES was not available and expansions were calculated on a commercially available spreadsheet with Macintosh computers. Details available from DAWR on request.

Calculation: A 362-day (363 days during leap years) expansion was run for each calendar year of survey data and was added to the results of the 3-day Guam International Fishing Derby

(GIFD) to produce catch and effort estimates for each fishing method surveyed. Percent species composition was calculated by weight for the sampled catch for each method to produce catch estimates for each species for the expanded period. The annual catch for all pelagic species and the PPMUS separately were summed across all methods to obtain the numbers plotted above except for 1992 which included only the trolling method.

Interpretation: Guam's pelagic fishery is growing, particularly the landings of non-tunas (other PPMUS). In the early 1980s, the bulk of the catch tended to consist of tunas, but since 1985 it has consisted of non-tuna (other) PPMUS. Reasons for this include a trend towards decreasing size and availability of yellowfin tuna from 1983 to 1989, lack of interest in skipjack tuna, and a increasing interest in targeting blue marlin. Virtually all landings (>99%) are by the trolling method.

Figure 2. Guam annual estimated total landings -- mahimahi and wahoo



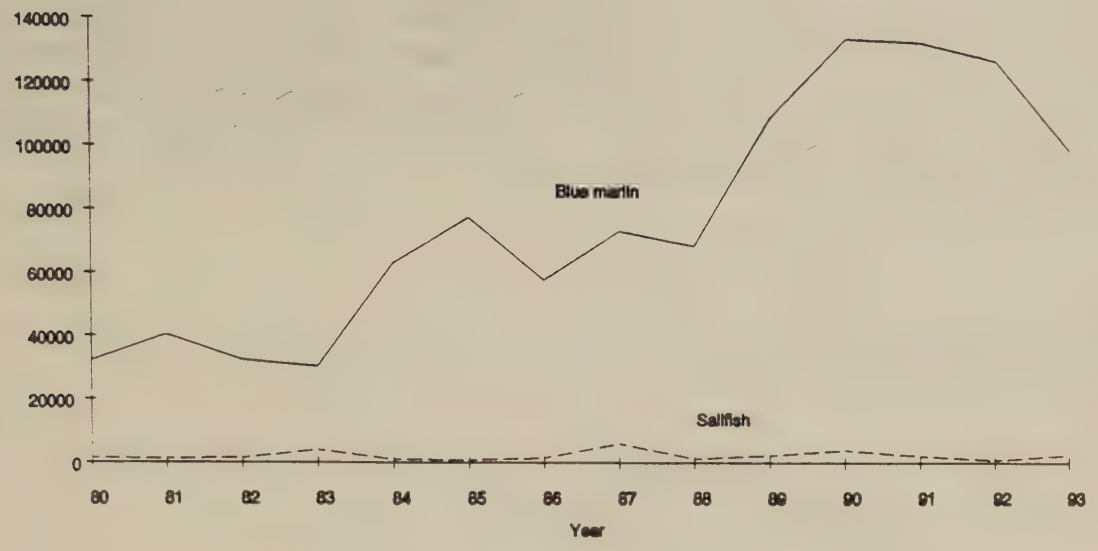
	Pounds Landed	
Year	Mahimahi	Wahoo
1980	203,136	32,825
1981	27,954	82,635
1982	160,200	66,416
1983	128,130	89,010
1984	28,847	56,501
1985	92,407	159,300
1986	85,393	68,830
1987	86,362	82,892
1988	310,032	99,801
1989	87,158	111,977
1990	126,968	66,107
1991	402,107	71,001
1992	136,421	112,872
1993	423,988	97,448

Source: The Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program and its associated computerized data expansion system files.

Calculation: Totals by species were summed across all fishing methods for all years except 1992-93 as described in Figure 1.

Interpretation: Landings of mahimahi exceeded those of all other species during eight of the past 14 years, making it the most important species in Guam's small boat fishery. Record high landings of mahimahi were recorded in 1993. This is consistent with a long-term pattern of extreme fluctuations. Wahoo landings have fluctuated widely, but not to the extreme exhibited by mahimahi. Wahoo landings were slightly lower in 1993 than in the previous year. Virtually all landings were by the trolling method.

Figure 3. Guam annual estimated total landings -- blue marlin and sailfish



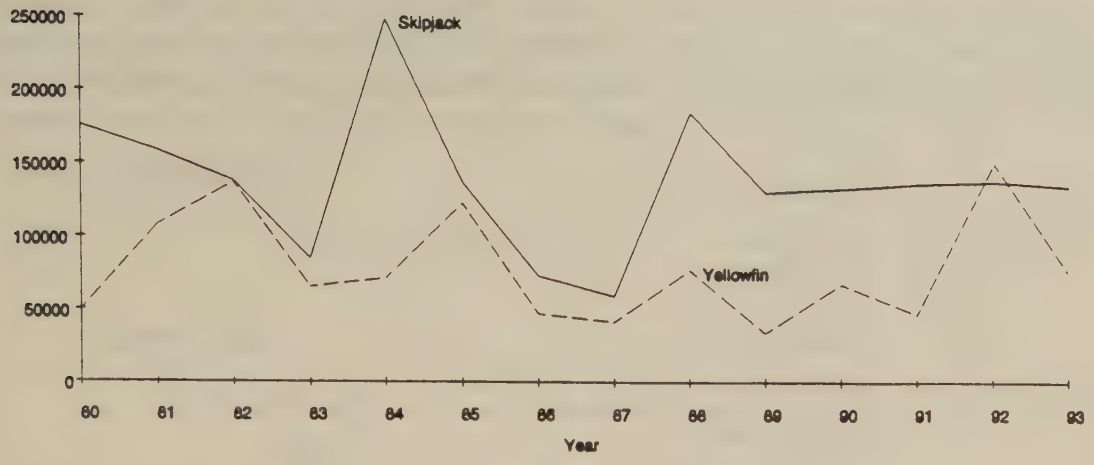
	Pounds Landed	
Year	Blue Marlin	Sailfish
1980	32,192	1,411
1981	40,389	1,272
1982	32,465	1,425
1983	30,359	3,820
1984	63,057	952
1985	77,565	915
1986	57,682	1,474
1987	73,169	5,913
1988	68,511	1,145
1989	109,241	2,191
1990	136,541	3,730
1991	129,992	2,000
1992	127,356	745
1993	98,698	2,379

Source: The Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program and its associated computerized data expansion system files.

Calculation: Totals by species were summed across all fishing methods for all years except 1992-93 as described in Figure 1.

Interpretation: Landings of blue marlin increased steadily between 1980 and 1990, remained high through 1992, then decreased during the past year. Growth was particularly rapid between 1988 and 1990. The rapid growth in the charter fleet was undoubtedly the reason for this growth in landings, and the decline in 1993 could be attributable to a decline in charter activity during the past year. Although statistics were not available, this decline in charter activity was probably a result of a decline in tourism due to a combination of a depressed economy in Japan and recent natural disasters on Guam. Some blue marlin were tagged and released during the past three years and that number is expected to grow. Sailfish landings have remained insignificant. Virtually all landings were by the trolling method.

Figure 4. Guam annual estimated total landings -- skipjack and yellowfin tunas



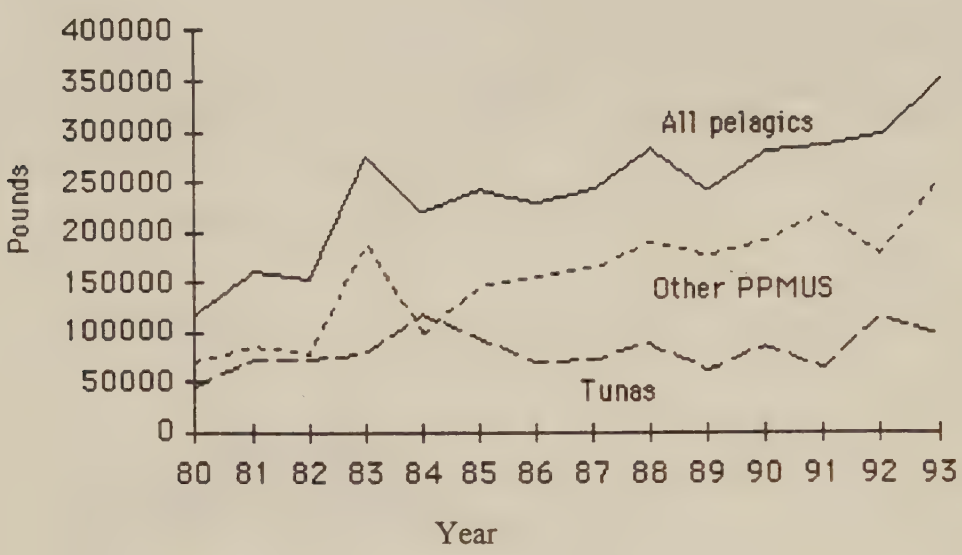
	Pounds Landed	
Year	Skipjack tuna	Yellowfin tuna
1980	175,542	49,386
1981	158,493	107,828
1982	137,735	137,202
1983	85,008	65,598
1984	248,243	71,502
1985	137,097	122,707
1986	73,199	47,290
1987	59,228	41,754
1988	184,838	77,434
1989	130,682	34,404
1990	133,460	68,076
1991	137,136	47,398
1992	138,547	151,025
1993	135,163	76,285

Source: The Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program and its associated computerized data expansion system files.

Calculation: Totals by species were summed across all fishing methods for all years except 1992-93 as described in Figure 1.

Interpretation: Landings of skipjack tuna exceeded those of all other species in 4 of the last 14 years, and were exceeded by mahimahi in all but one of the remaining years. Landings of skipjack tuna have always exceeded those of yellowfin tuna, often by at least a 2:1 margin. Given the poor marketability of skipjack tuna in Guam, and the desirability of yellowfin tuna, the availability of skipjack tuna probably exceeds that of yellowfin tuna by a wider margin than this chart would suggest. Virtually all landings were by the trolling method.

Figure 5. Guam annual estimated commercial landings -- all pelagics, tunas, and other PPMUS



	Pounds Landed		
Year	All Pelagics	Tunas	Other PPMUS
1980	118,275	45,043	70,319
1981	162,186	72,229	84,371
1982	153,577	72,347	77,602
1983	273,120	79,313	189,241
1984	220,074	118,167	98,412
1985	243,060	94,691	143,509
1986	227,928	68,510	154,749
1987	240,790	71,711	163,449
1988	283,264	87,962	188,498
1989	242,554	59,825	178,424
1990	279,121	84,176	190,201
1991	285,696	64,694	218,588
1992	296,809	114,765	178,307
1993	351,201	96,289	250,211

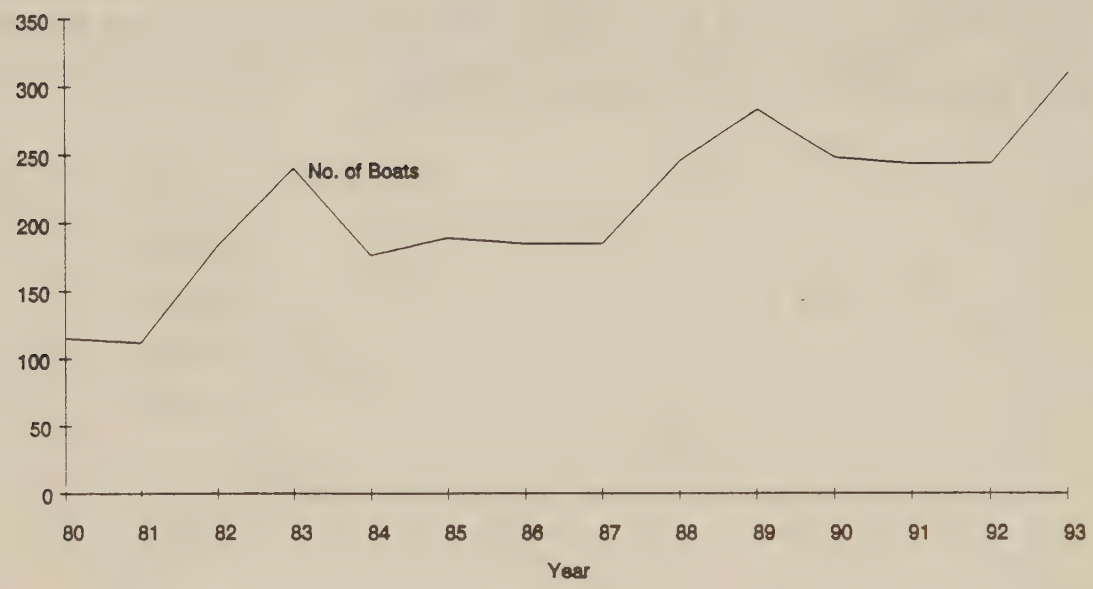
Source: The WPacFIN-sponsored commercial landings system.

Calculation: The total estimated commercial landings for each year were calculated by summin the weight fields in the commercial landings data base from the principle fish wholesalers on Guam, and then multiplying by an estimated percent coverage expansion factor. The annual expansion factor was created subjectively based on as much information as possible, including a analysis of the disposition of catch (available from the DAWR offshore creel survey), an evaluation of the fishermen in the fishery and their entry/exit patterns, general dockside

knowledge of the fishery and the status of the marketing conditions and structure, and the estimated trip coverage rate.

Interpretation: Commercial pelagic fishery landings appears to have increased steadily for the last 14 years, but very few of the fishermen landing fish commercially have been full-time fishermen. The growing charterboat industry is certainly adding to the growth of the pelagic fishery because nearly all of the charters are for trolling.

Figure 6. Guam estimated number of trolling boats



Year	Number of Boats
1980	115
1981	112
1982	183
1983	240
1984	176
1985	189
1986	184
1987	184
1988	245
1989	282
1990	247
1991	242
1992	242
1993	309

Source: The Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program and its associated computerized data expansion system files.

Calculation: Since only a fraction of the days of the year were actually sampled, it was not possible to know the exact number of boats participating in the fishery. Therefore, a "returning

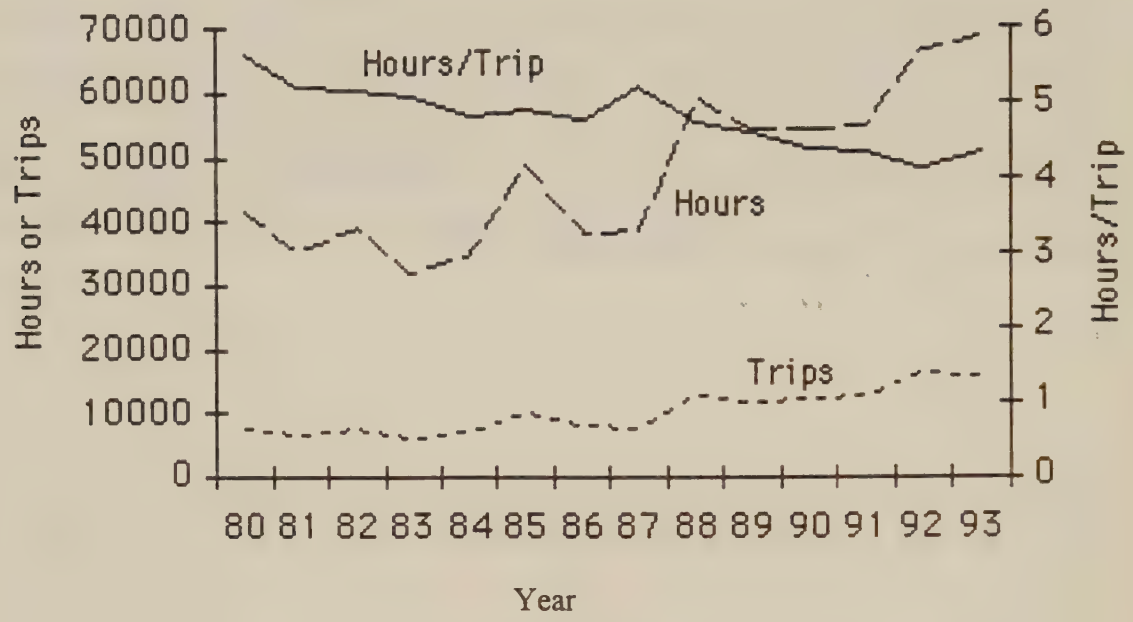
vessel threshold" model[1] was run a minimum of 50 times per year, and the median estimated number of boats was selected from the sorted list of model estimates.

Interpretation: There is a general increase in the number of small boats participating in Guam's fisheries during the past 14 years. The figures shown here, however, may be an underestimate since only a single site was sampled for most years and a second site was sampled on fewer days for the years 1980-81 and 1989-93. There were undoubtedly boats participating in pelagic fisheries that never utilized the sampled sites during any given year. Prior to 1991, this number was probably less than 50 since there were a limited number of launch sites. With the opening of the Agat Marina in 1991, a larger number of boats were not reached by the survey, and the figures given for 1991-93 are unrealistically low.

---

[1] Satchiendrakumar, R. and C.A. Tisdell. 1987. Optimal economic fishery effort in the Maldivian tuna fishery: an appropriate model. Mar. Res. Econ. 4: 15-44.

Figure 7. Guam annual estimated pelagic species trips, hours, and hours per trip for trolling



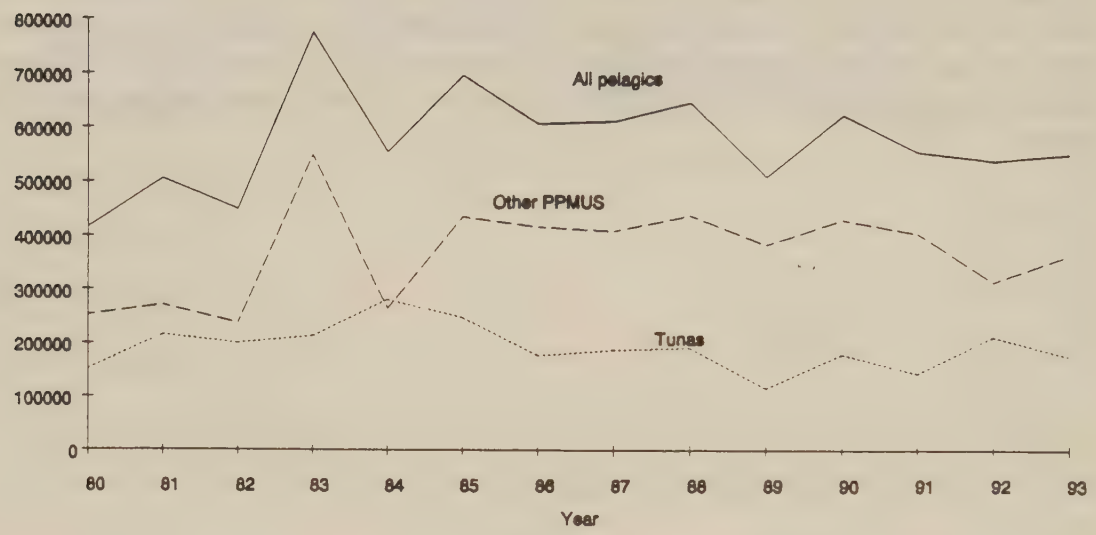
Year	Hours	Trips	Hours/Trip
1980	41,870	7,394	5.7
1981	35,430	6,763	5.2
1982	39,146	7,566	5.2
1983	32,085	6,287	5.1
1984	35,196	7,276	4.8
1985	48,823	9,900	4.9
1986	38,201	7,992	4.8
1987	38,475	7,342	5.2
1988	58,874	12,454	4.7
1989	54,119	11,725	4.6
1990	54,486	12,340	4.4
1991	54,686	12,523	4.4
1992	66,535	16,076	4.1
1993	68,609	15,810	4.3

Source: The Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program and its associated computerized data expansion system files.

Calculation: The data expansion system was run on a calendar year's worth of survey data to produce catch and effort estimates for each fishing method surveyed. These plots are of the estimated boat hours spent fishing and number of trips for the trolling method as taken directly from creel survey expansion system printouts.

Interpretation: Guam's pelagic fishery is growing, particularly the charterboat segment which has more than doubled during the past few years. Recent back-to-back years of record high effort as boat hours spent fishing and boat trips was likely caused by a combination of record charterboat activity in 1992 and a high abundance of mahimahi in 1993. The slight drop in number of boat trips and corresponding increase in hours per trip during the past year is most likely due to a drop in charter boat activity caused by the combination of a recession in Japan's economy and natural disasters on Guam. Since most charter trips are for a half-day, mean trip duration decreases as charter boat activity increases. Effort is expected to continue its long-term growth.

Figure 8. Guam annual estimated commercial inflation-adjusted total revenues -- all pelagics, tunas, and other PPMUS



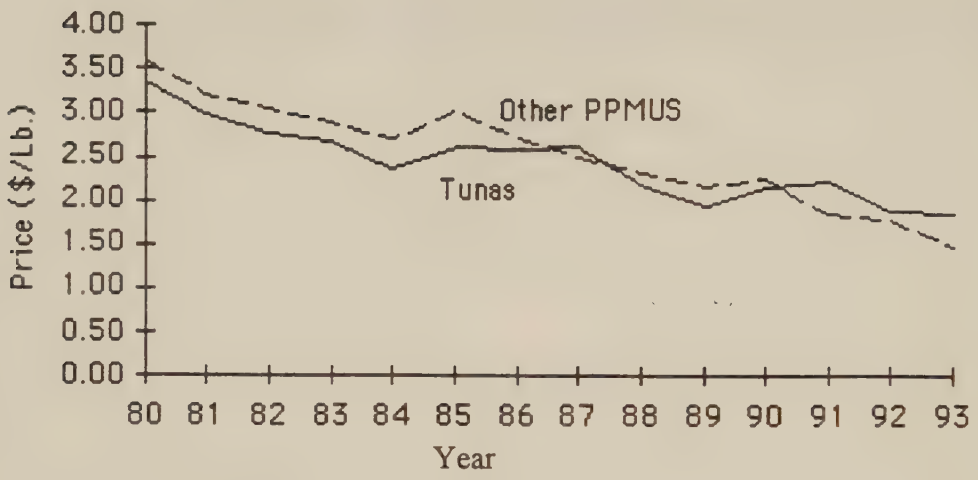
	Revenues ($)					
	All Pelagics		Tunas		Other PPMUS	
Year	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
1980	149,160	415,112	54,353	151,263	90,623	252,204
1981	218,384	504,468	92,914	214,632	117,052	270,391
1982	203,847	447,853	90,719	199,310	107,573	236,338
1983	364,527	774,256	100,029	212,462	258,501	549,055
1984	283,724	554,113	143,598	280,447	135,498	264,628
1985	369,651	694,944	131,953	248,072	230,855	434,008
1986	330,302	604,783	96,395	176,499	226,935	415,517
1987	347,753	609,612	107,055	187,667	233,116	408,652
1988	386,468	643,856	114,981	191,559	261,901	436,327
1989	337,586	507,054	76,865	115,452	253,932	381,406
1990	471,241	619,683	136,321	179,262	325,372	427,864
1991	462,191	551,393	119,640	142,731	337,328	402,432
1992	492,707	533,602	195,547	211,777	289,129	313,126
1993	547,835	547,835	175,360	175,360	362,728	362,728

Source: The WPacFIN-sponsored commercial landings system.

Calculation: The total estimated revenue for each year was calculated by summing the revenue fields in the commercial landings data base from the principle fish wholesalers on Guam, and then multiplying by the same percent coverage expansion factor as were the landings in Figure 5 Inflation-adjusted total revenue per trip was derived from the Guam annual Consumer Price Inde (CPI).

Interpretation: Revenues for all pelagic species and other PPMUS remained fairly steady from 1985-90, followed by a drop since then. Revenues for tunas have shown a slight increase since 1989. This indicates an overall declining economic condition of the harvester industry when one considers that commercial landings for the same period have increased (Fig. 5).

Figure 9. Guam average inflation-adjusted price of tunas and other PPMUS



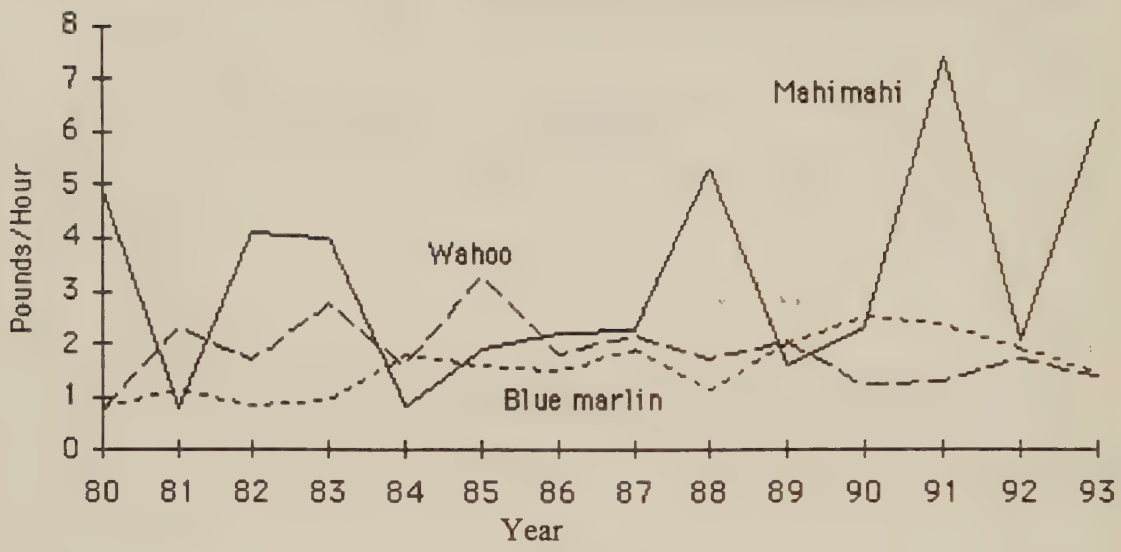
	Price ($/lb)			
	Tunas		Other PPMUS	
Year	Unadjusted	Adjusted	Unadjusted	Adjusted
1980	1.21	3.36	1.29	3.59
1981	1.29	2.97	1.39	3.20
1982	1.25	2.75	1.39	3.05
1983	1.26	2.68	1.37	2.90
1984	1.22	2.37	1.38	2.69
1985	1.39	2.62	1.61	3.02
1986	1.41	2.58	1.47	2.69
1987	1.49	2.62	1.43	2.50
1988	1.31	2.18	1.39	2.31
1989	1.28	1.93	1.42	2.14
1990	1.62	2.13	1.71	2.25
1991	1.85	2.21	1.54	1.84
1992	1.70	1.85	1.62	1.76
1993	1.82	1.82	1.45	1.45

Source: The WPacFIN-sponsored commercial landings system.

Calculation: The average price of tunas and other PPMUS were calculated by dividing the tota revenue for each by the sold weight. The inflation adjustment was made by using the Consume Price Index (CPI) for Guam and establishing the 1993 figure as the base from which to calculat expansion factors for all previous years (e.g., divide the 1993 CPI by the CPI of any given year and then multiplying that factor by the unadjusted average price for the given year.

Interpretation: The inflation-adjusted price of tunas and other PPMUS shows a general decline during the past 14 years. While the decline does not promote a healthy atmosphere for the commercial fishery, it does not necessarily adversely affect the charterboat industry since their success does not directly depend on the price of fish.

Figure 10. Guam trolling catch rates -- mahimahi, wahoo, and blue marlin



	Pounds Per Hour Fished		
Year	Mahimahi	Wahoo	Blue Marlin
1980	4.9	0.8	0.8
1981	0.8	2.3	1.1
1982	4.1	1.7	0.8
1983	4.0	2.8	0.9
1984	0.8	1.6	1.8
1985	1.9	3.3	1.6
1986	2.2	1.8	1.5
1987	2.2	2.2	1.9
1988	5.3	1.7	1.2
1989	1.6	2.1	2.0
1990	2.3	1.2	2.5
1991	7.3	1.3	2.4
1992	2.0	1.7	1.9
1993	6.2	1.4	1.4

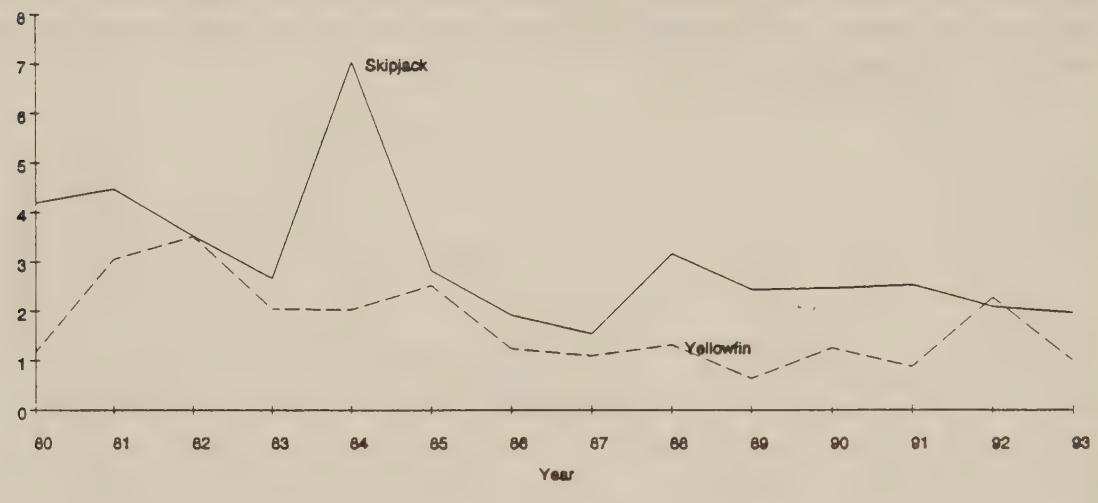
Source: The Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program and its associated computerized data expansion system files.

Calculation: The data expansion system for the survey data was run by calendar year to produ catch and effort estimates for each fishing method. This plot and table of catch per unit of effo (CPUE) were based on the total annual landings of mahimahi, wahoo, and blue marlin, each divided by the total number of hours spent fishing (gear in use).

Interpretation: The wide fluctuations in CPUE were probably due to the high variability in th year to year abundance and availability of the stocks. However, since it was not possible to

allocate species-specific effort, effort used to target other species can also result in artificially high or low catch rates for a given species. No general trend in CPUE is apparent for mahimahi or wahoo. However there does seem to have been a general increase in the catch rate of blue marlin during the 1980s. This was probably a result of growth of the charter component of the fleet since the charter vessels tend to be larger than average and tend to target marlin more frequently than the smaller boats.

Figure 11. Guam trolling catch rates -- skipjack and yellowfin tunas



	Pounds Per Hour Fished	
Year	Skipjack Tuna	Yellowfin Tuna
1980	4.2	1.2
1981	4.5	3.0
1982	3.5	3.5
1983	2.6	2.0
1984	7.1	2.0
1985	2.8	2.5
1986	1.9	1.2
1987	1.5	1.1
1988	3.1	1.3
1989	2.4	0.6
1990	2.5	1.3
1991	2.4	0.8
1992	2.1	2.3
1993	2.0	1.0

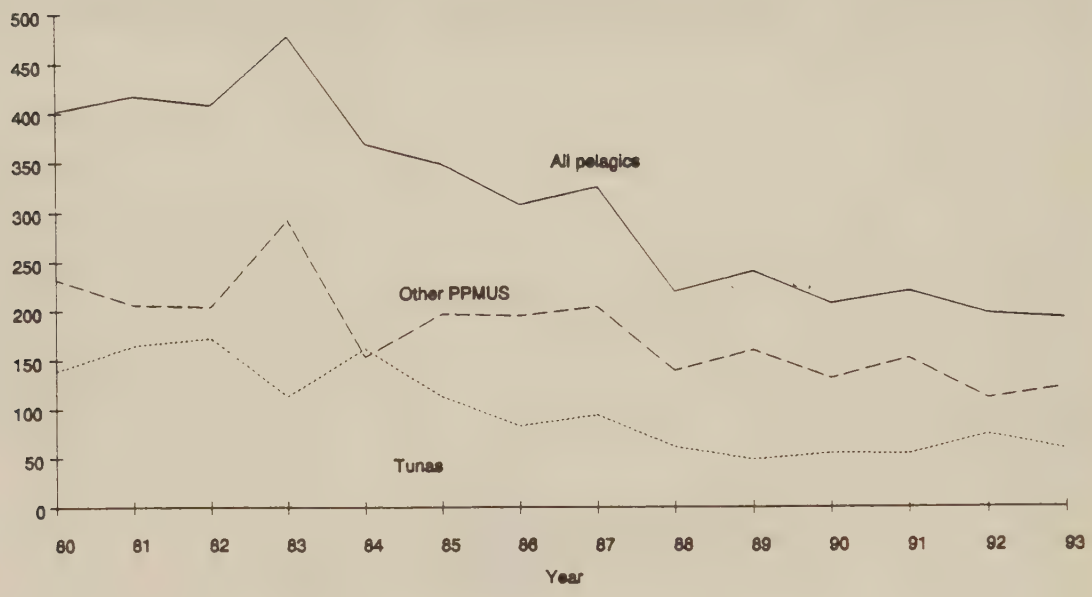
Source: The Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program and its associated computerized data expansion system files.

Calculation: The data expansion system for the survey data was run by calendar year to produ catch and effort estimates for each fishing method. This plot and table were calculated in the same way as Figure 10.

Interpretation: The wide fluctuations in CPUE for tunas were probably due to the high variability in the year-to-year abundance and availability of the stocks. However, there is some indication of a general decline in the CPUE of both skipjack and yellowfin tuna between 1982 and 1989. This could have been a result of either declining abundance of the stocks, or

decreasing availability due to interception by the purse-seine or longline fleets in or near the Guam EEZ, or both. It is also possible that a large annual effort directed at one or more other trolling species could result in an artificial decline in the CPUE of the species shown here. If the decline was due to interception by purse-seine or longline fleets, restriction of their operations from the waters near Guam and its offshore banks could alleviate the problem.

Figure 12. Guam inflation-adjusted revenues per trolling trip landing tunas or other PPMUS



	Revenues per Trip ($)					
	All Pelagics		Tunas		Other PPMUS	
Year	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
1980	144	402	50	139	84	232
1981	181	417	71	164	89	206
1982	186	408	78	172	93	204
1983	224	477	53	113	137	292
1984	189	369	83	162	78	153
1985	185	348	60	113	105	197
1986	168	307	45	83	107	195
1987	185	325	53	94	116	204
1988	132	219	37	61	83	139
1989	159	239	32	48	107	160
1990	157	207	42	55	99	131
1991	183	219	45	54	127	151
1992	181	196	69	74	102	110
1993	192	192	59	59	122	122

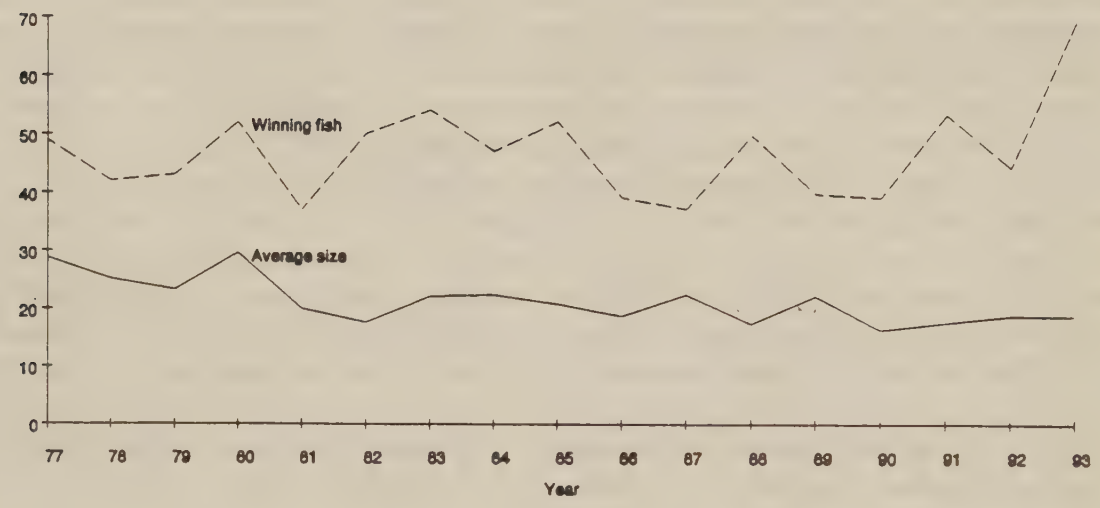
Source: The WPacFIN-sponsored commercial landings system.

Calculation: The average revenue per trip was calculated by summing the revenue of all speci sold then dividing by the number of trips, and summing the revenue of tunas and other PPMUS sold and then dividing each by the number of trips, respectively, for any trip which landed

PPMUS. Adjusted revenue per trip was derived from the Guam annual Consumer Price Index (CPI).

Interpretation: Adjusted revenue per trip for all pelagics, tunas and other PPMUS have experienced a general decline during the past 14 years. This cannot be attributed to the trend towards decreasing trip length since the decrease in revenues is considerably greater and since the charter fleet which tends to take shorter trips generally combine daily catches from 2-3 trips into a single trip receipt. One must be careful in interpreting these data for the Guam fishery because they were subject to biases created by marketing problems and the market structure upon which the data collecting system is based. For instance, 1988, 1991, and 1993 were record high years for abundance and landings of mahimahi. One might expect the per-trip landings to be high for a year which had record landings. However, because of the glut on the market during the mahimahi season, and because of other marketing problems, the per trip revenue was unusually low. This was partly because purchase limits were placed on fishermen, e.g., only certain fishermen's catches would be purchased (Co-op members), and even then a 50-pound maximum limit was occasionally placed on mahimahi. This caused fishermen to either stop fishing at all, stop fishing when they caught 50 pounds, or start marketing some of their catch elsewhere, which further increased Co-op marketing problems.

Figure 13. Guam International Fishing Derby average size and size of winning fish -- wahoo



Year	Number Caught	Average Size (lb)	Winning Fish (lb)
1977	7	28.7	49
1978	9	25.1	42
1979	11	23.2	43
1980	12	29.5	52
1981	60	20.0	37
1982	33	17.6	50
1983	36	22.1	54
1984	46	22.3	47
1985	98	20.7	52
1986	16	18.7	39
1987	31	22.3	37
1988	72	17.3	49.5
1989	59	22.0	39.5
1990	34	16.2	38.9
1991	40	17.4	52.9
1992*	38	18.7	44.0
1993	19	18.6	69.2

*Third day of derby cancelled; results based on 2 days of fishing.

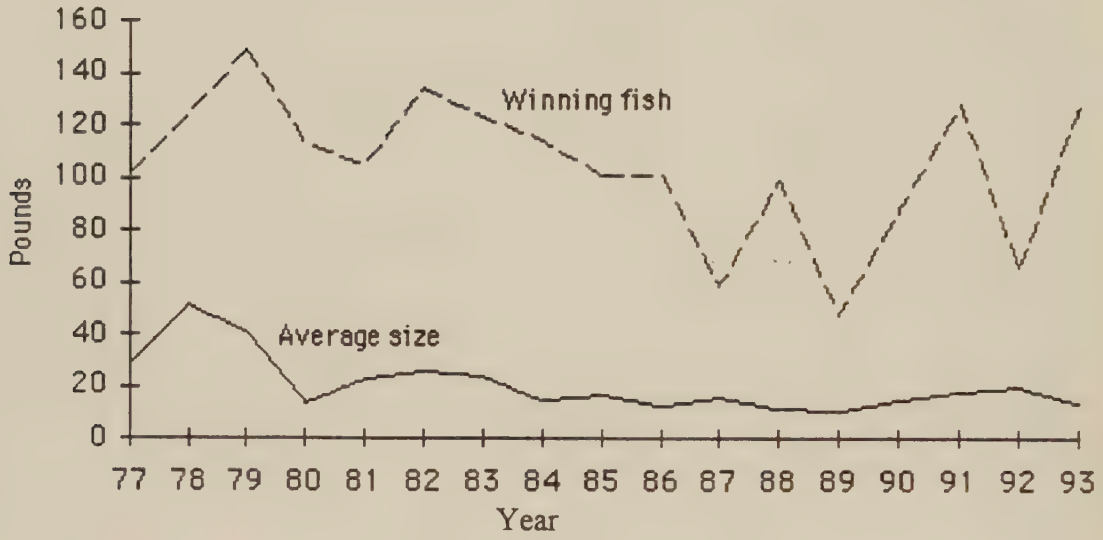
Source: The Division of Aquatic and Wildlife Resources (DAWR) annual reports.

Calculation: The Guam International Fishing Derby (GIFD) is an annual three-day event that occurs in July or August. Most of the wahoo caught were measured or weighed by derby

officials. The figures here include some fishes whose weights were based on an average or estimate.

Interpretation: No general trend is apparent over the last 16 years.

Figure 14. Guam International Fishing Derby average size and size of winning fish -- yellowfi
tuna



Year	Number Caught	Average Size (lb)	Winning Fish (lb)
1977	18	29.3	102
1978	11	51.2	125
1979	34	41.2	149
1980	50	13.7	113
1981	109	23.4	105
1982	205	25.6	135
1983	100	24.5	123
1984	59	14.6	114
1985	137	17.0	101
1986	71	12.6	101
1987	116	15.3	59
1988	161	11.6	99
1989	81	10.5	47.5
1990	81	14.9	88
1991	102	17.4	127.4
1992*	99	19.8	65.0
1993	103	14.1	127.6

*Third day of derby cancelled; results based on 2 days of fishing.

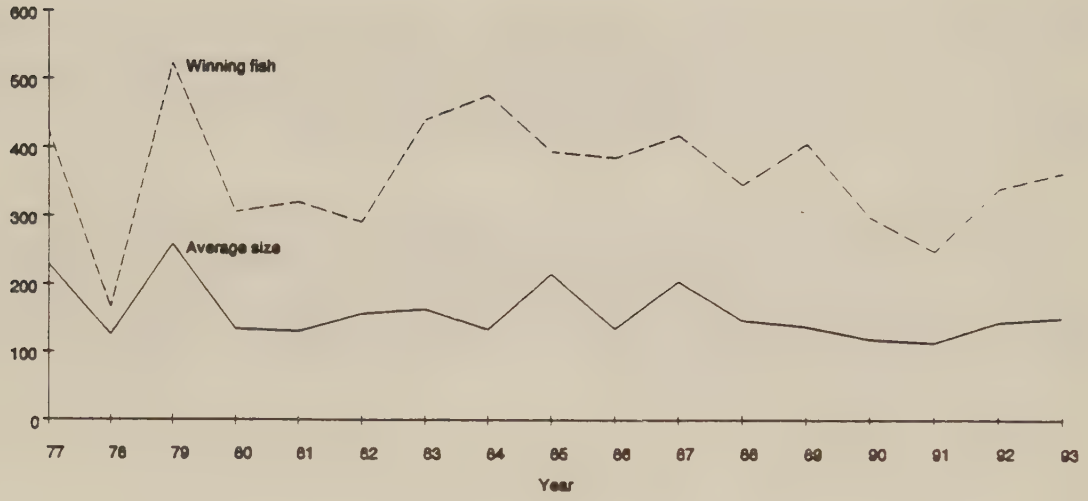
Source: The Division of Aquatic and Wildlife Resources (DAWR) annual reports.

Calculation: The Guam International Fishing Derby (GIFD) is an annual three-day event that occurs in July or August. Most of the yellowfin tuna caught were measured or weighed by derby officials. The figures here include some fishes whose weights were based on an average or estimate.

Interpretation: The size of the winning fish has fluctuated widely since 1986. This may indicate a lowered abundance of relatively large fishes since then. There seems to have been a slight recovery in the average size from 1989-92 following a general decline during the previous ten years. However the average size was down again in 1993.

Average size may fluctuate on a 4-5 year cycle, which could be indicative of year-classes passing through the fishery or some oceanographic-availability phenomenon. The maximum average size (amplitude) of the cycles seems to have declined. The variance of the winning fish data increased markedly after 1986 indicating a different "statistical population" and probably some significant change in the fishery and/or resource.

Figure 15. Guam International Fishing Derby average size and size of winning fish -- blue marlin



Year	Number Caught	Average Size (lb)	Winning Fish (lb)
1977	9	228.4	423
1978	9	125.2	166
1979	6	258.4	523
1980	12	133.6	306
1981	34	130.1	320
1982	12	156.6	291
1983	13	163.6	439
1984	47	133.2	475
1985	17	215.2	392
1986	47	134.1	383
1987	43	203.9	415
1988	58	145.7	342.5
1989	86	136.7	402
1990	64	117.9	295
1991	61	112.0	245
1992*	42	142.5	336.0
1993	27	148.4	358.5

*Third day of derby cancelled; results based on 2 days of fishing.

Source: The Division of Aquatic and Wildlife Resources (DAWR) annual reports.

Calculation: The Guam International Fishing Derby (GIFD) is an annual three-day event that occurs in July or August. Most of the billfishes caught were measured or weighed by derby

officials. The figures here may include a few fishes whose weights were based on an average or estimate.

Interpretation: No general trend is apparent over the last 16 years. However there seems to have been a slight decline in the size of the winning fish and average size between 1987 and 1991 followed by a recovery during the last two years.

Appendix 3

Hawaii

Introduction

This report contains information from two sources: the Hawaii Department of Land and Natural Resources Division of Aquatic Resources (HDAR) and the National Marine Fisheries Service Honolulu Laboratory (NMFS). The sources of data are noted with each table and graph.

The staff of the HDAR compiled the data on the non-longline Hawaii pelagic fisheries in calendar year 1993 and prepared this report. Data on troll, handline and baitboat landings, CPUE, and revenue came exclusively from the HDAR commercial catch reporting system. Historical troll and handline data (1987-91) had been revised using HDAR data to maintain consistency with 1992 and 1993 data. Please note, therefore, that information reported in annual reports previous to 1992 are not directly comparable to this 1993 report.

The HDAR summaries were produced from the State's mandatory commercial catch reporting system. Every fisherman, including captain and crew, who sells any marine species is required by the State to have a Commercial Marine License and, unless specifically exempted[1], is required to submit a catch report monthly to the HDAR.

Commercial Marine Licenses were issued on a fiscal year basis, so the following data are from fiscal year 1993 (July 1992 through June 1993). A total of 3,836 fishermen were licensed, of which 2,800 were required to report. The HDAR received 25,642 reports, or 87.8% of a total of 29,196 expected, as of February 1994. The HDAR asked fishermen to identify their primary fishing gear/method on the Commercial Marine License at the time of licensing. This did not preclude fishermen from using other gears or methods, but indicated what they considered to be their primary method (numbers in parentheses indicate change from FY92). According to the licenses, 1,586 were trollers (+2.9% from 1992), 682 were longliners (-10.5%), 161 (+3.2%) were handliners (*ika-shibi* or *palu-ahi*), and 62 were baitboat fishermen (-1.6%), for a total of 2,491 pelagic fishermen (-1.2%). Of these, 1,473 trollers (+4.2%), 144 longliners (-8.3%), 144 handliners (+1.4%), and 11 baitboat fishermen (+22.2%) were required to submit catch reports to DAR, for a total of 1,772 (+3.0% from 1992).

As in the 1992 pelagics annual report, these summaries represent recent changes in the HDAR Commercial Fisheries Statistical Charts. Fishermen must report the area where they made their catches using statistical charts provided by the HDAR. A new set of charts went into effect in July 1990, which provided new statistical area codes for areas that were not covered by old charts. This accommodated fishermen who were fishing beyond the boundaries of the old charts. The data presented here include data from areas covered by the new 1990 charts, covering the entire Hawaiian Archipelago.

---

[1] Only one person per vessel is required to submit a catch report. This person is usually the captain or a representative of the owner. Crew members are generally not required to submit catch reports.

The HDAR does not collect recreational fish catch data because no authority or mechanism exists to accomplish this. The HDAR contracted a one-time survey of small-boat commercial and recreational fishermen in 1990-91 at ports around the island of Oahu, at the request of the Western Pacific Regional Fishery Management Council and with funding and guidance from the NMFS. The data from the one-year survey were analyzed by the Honolulu Laboratory. A preliminary report is available from the Honolulu Laboratory or from the Council[2]. The lack of long-term recreational data, lack of data on unlicensed commercial fishermen, and lack of validation of current data sets remain serious problems.

The staff of the NMFS Fishery Monitoring and Economics Program (FMEP) compiled the data and prepared the estimates of the pelagic longline fishery. Estimates for longline landings, CPUE, and revenue came from the NMFS longline logbooks and the NMFS/HDAR wholesale market monitoring programs. Estimates of 1993 longline landings were made using 1993 logbook data in numbers of fish and 1992 average weights, because 1993 average weights were not yet available. Statistics on longline landings were estimated by the NMFS using a procedure explained more fully in a separate NMFS report "Western Pacific Pelagic Fisheries in 1991[3] ".

The NMFS estimates for 1987-90 were compiled by extrapolating market monitoring information on a substantial sample of longline trips. The NMFS estimates for 1991-93 were constructed by combining NMFS figures on average size of longline fish landed in Honolulu with NMFS longline logbook figures on the number of longline caught fish which were recorded as "kept".

The NMFS estimates for 1993 are preliminary because of the possibility of late arriving logbooks and re-compilation of average weights from the market monitoring program. The final longline logbook numbers will be reported by the NMFS in a separate annual report on the longline logbook program, and the final estimates of longline landings will be reported in an additional NMFS report. These reports will be completed by summer 1994.

Summary

Total pelagic landings increased by 20%, nominal revenue increased 17%, and adjusted revenue rose by 14%. Almost all species showed an increase in landings, except for mahimahi, which decreased by 27%. Non-tuna PPMUS landings increased 17%, nominal revenue was up by 17%, and adjusted revenue rose 13%. Total tuna landings rose 26%, nominal revenue increased 21%, and adjusted revenue was up by 17%. As in recent years, non-tuna PPMUS landings and revenue exceeded tuna landings and revenue, largely due to the swordfish longline fishery.

Longline trends

The NMFS longline logbooks show a slow growth in the fishery in 1993. There were 7% more sets made in 1993 (compared to 1992), and 11% more hooks set. About 5,500 more swordfish were caught (+7%), but also substantially more bigeye tuna (11,000 or +25%) and yellowfin tuna

---

[2] Hamm, David C., and Henry K. Lum. 1992. Preliminary results of the Hawaii small-boat fisheries survey. National Marine Fisheries Service, Honolulu Laboratory Administrative Report H-92-88.

[3] Ito, Russell Y. 1992. Western Pacific Pelagic Fisheries in 1991. NMFS Southwest Fisheries Science Center Honolulu Laboratory, Administrative Report H-92-15.

(8,250 or more than double the 1992 figure). Marlins were approximately the same as 1992, and substantially fewer mahimahi were caught in 1993. Catch per unit effort roughly approximated the same trends as catch.

There were several notable changes in the fishery. First, shark landings increased dramatically in 1993, but they were being landed as fins[4]. The number of sharks reported "kept" in the NMFS longline logbooks was 16,758 in 1993, and the vast majority of these were "kept" as fins (14,500 were blue sharks valued in Hawaii only for their fins). Estimates of actual weights transacted and approximate prices will be included in the NMFS annual report on the pelagic fishery.

Second, bluefin tuna are being landed in increasing numbers by the longline fishery as the vessels range further north from Hawaii. Although the number of bluefin landed is relatively small (approximately 100 in 1993), they were worth over $13.00/lb (round weight, ex-vessel). Bluefin tuna were combined with skipjack tuna in the "other tuna" weights and prices in this report, so the 1993 jump in price is a reflection of changing species composition.

Third, the average aggregate pelagic species price has declined in nominal (current value) terms over the three years and in real (inflation-adjusted) terms prices were below those in 1985. However, much of this change in aggregate price derives from changes in the relative contribution of various species in the aggregate price. Nominal tuna prices rose in 1992 and 1993 following a substantial dip in 1991, despite substantially higher tuna landings in 1993. Billfish prices have stayed relatively constant in nominal terms (and inflation has had only a minor bearing on inflation-adjusted prices in recent years).

Fourth, while NMFS estimates and HDAR figures on the longline fishery have begun to converge in recent years, the difference between the two remains substantial. (In 1993, the NMFS estimated landings were 26.1 million lb while the HDAR figures were 15.2 million lb). One important feature of HDAR figures is that they appear to report "landed weight" rather than an estimated "whole weight". Since swordfish were primarily processed at sea and landed as a headed, gilled and gutted product, this could account for the 24% difference in NMFS and HDAR landings figures. This also accounts for a substantial part of the reason that HDAR swordfish prices ($3.02/lb, landed weight) were much higher than NMFS swordfish prices ($2.00/lb, whole weight). A similar problem may apply to shark landings.

Other Pelagic Fisheries Trends

In general, the commercial troll, handline, and baitboat fisheries, as reported to the HDAR, showed moderate changes in 1993. Total landings for troll increased 4%, handline rose about 11%, and baitboat went up about 24%. Total nominal revenues changed -3% for commercial troll, +22% for handline, and 0% for baitboat.

Troll and handline landings of mahimahi continued to decline from the peak in 1991, and were lower than the long-term average. Blue marlin landings increased slightly. Wahoo landings remained about the same as 1992, while striped marlin landings nearly doubled and set a new

[4] The NMFS estimates landings by calculating "whole weight" for all species, which for swordfish and sharks, involves conversions for dressed carcasses and fins, respectively.

high. Yellowfin increased slightly, but remained near the long-term average. Bigeye tuna landings were much lower (-40%), but slightly above the long-term average, and skipjack landings were about the same.

Baitboat landings, primarily skipjack, increased by 24%.

Catch rates for major pelagic species caught by trollers generally decreased slightly from 1992. On the other hand, catch rates for handliners and baitboat fishermen generally increased, except for handline bigeye. The handline yellowfin catch rate has risen steadily since 1990 and reached a record peak in 1993.

Recommendations

1. See the Introduction section of the annual report for detailed fishery data recommendations for Hawaii.

2. Regarding the Hawaii longline logbook reporting system, the NMFS FMEP should:
   a. Continue efforts to improve species identifications by vessel operators, especially for marlin species.
   b. Monitor landings of shark fins to estimate total processed weights and values.
   c. Encourage vessel operators to identify bluefin tunas in the logbook, and modify the NMFS computer routines to account for bluefin.
   d. Compare HDAR and NMFS landings information on a trip-by-trip basis for species identification, numbers landed, etc.
   e. Incorporate into the annual report a 1991-94 time series of longline effort and catch rates for major species.

3. The University of Hawaii's Pacific Fisheries Research Program (PFRP) should develop (through the "HI CEA" project) a pre-1991 time series of longline, troll, and handline effort and catch rates for major species.

4. The PFRP "HI-FIVE" project should analyze the economic impacts of the main Hawaiian islands longline area closures and entry moratorium.

5. HDAR field personnel should be encouraged to improve species identification by state license holders, as well as data coding, for marlins (especially blue and striped) and ahi (bigeye and yellowfin).

6. NMFS recommends that pelagic data continue to be compiled from three sources: the NMFS longline logbook, the HDAR commercial catch reports, and the collaborative NMFS/HDAR market monitoring program. The HDAR data appear to provide a relatively consistent long-term time-series for non-longline gears, while the NMFS landings estimates appear to provide an up-to-date record of the longline fishery[5].

---

[5] NMFS longline estimates are also the only viable tracking of the fishery during the late 1980s and early 1990s, as has been noted previously.

Tables

page

1. Hawaii domestic commercial landings, revenue and prices, 1992-93 3-6
2. Hawaii commercial pelagic landings and revenue by gear, 1992-93 3-7
3. Hawaii longline landings, catch per unit effort, and revenue, 1992-93 3-8
4. Average size of fish (in pounds) by gear type 3-9

Figures

page

1. Inflation-adjusted prices of pelagics 3-10
2. Hawaii commercial pelagic landings and revenue 3-11
3. Hawaii total commercial pelagic landings by gear type 3-12
4. Hawaii non-tuna commercial PPMUS landings by gear type 3-13
5. Hawaii commercial tuna landings by gear type 3-14
6. Hawaii non-tuna PPMUS landings and revenue 3-15
7. Species composition of Hawaii commercial billfish landings 3-16
8. Hawaii commercial landings -- mahimahi, wahoo, and sharks 3-17
9. Hawaii tuna landings and revenue 3-18
10. Species composition of Hawaii commercial tuna landings 3-19
11. Hawaii longline vessel activity 3-20
12. Hawaii longline landings and revenue 3-21
13. Hawaii longline landings -- billfish 3-22
14. Hawaii longline landings -- tunas 3-23
15. Hawaii troll and handline landings and revenue 3-24
16. Hawaii commercial troll and handline landings -- non-tuna PPMUS 3-25
17. Hawaii commercial troll and handline landings -- tunas 3-26
18. Hawaii commercial pelagic trips by non-longline gear 3-27
19. Commercial trolling catch per trip -- mahimahi, wahoo and blue marlin 3-29
20. Commercial trolling catch per trip -- yellowfin, skipjack and kawakawa 3-31
21. Commercial catch per trip for skipjack, troll and baitboat 3-33
22. Combined commercial handline catch per trip -- swordfish, mahimahi, wahoo, and blue marlin 3-35
23. Combined commercial handline catch per trip -- yellowfin, albacore and bigeye tunas . 3-37

Table 1. Hawaii domestic commercial landings, revenue and prices, 1992-93

Species	1992 Pounds Landed (x 1,000)	1992 Ex-vessel Revenue (x $1,000)	1992 Ave. Price ($/lb)	1993 Pounds Landed (x 1,000)	1993 Ex-vessel Revenue (x $1,000)	1993 Ave. Price ($/lb)
Swordfish	12,600	24,300	1.92	13,500	26,900	2.00
Blue marlin	1,300	1,300	1.00	1,500	1,200	0.90
Striped marlin	1,100	1,400	1.26	1,300	1,600	1.24
Other billfish	300	300	1.07	300	300	0.95
Mahimahi	1,100	2,000	1.76	800	1,400	1.98
Wahoo	400	1,000	2.54	500	1,000	2.19
Sharks	600	400	0.62	2,600	3,000	1.15
Non-Tuna PPMUS Subtotal	**17,500**	**30,700**	**na**	**20,500**	**35,400**	**na**
Bigeye tuna	3,500	12,200	3.52	4,200	14,500	3.44
Yellowfin tuna	3,000	6,200	2.08	3,700	8,300	2.33
Albacore	900	1,100	1.21	1,200	1,500	1.19
Other tunas	3,000	3,400	1.58	2,600	3,000	1.17
Tuna Subtotal	**9,500**	**22,900**	**na**	**11,800**	**27,300**	**na**
Other pelagics	400	600	1.61	400	500	1.05
TOTAL	**27,400**	**54,200**	**1.98**	**32,900**	**63,500**	**1.95**

Source and Calculation: NMFS estimates based on federal longline logbooks (number landed) and shoreside monitoring (average weight per fish) by NMFS and HDAR, and HDAR commercial catch reports for non-longline gears. Totals were calculated by summing separate estimates for longline, baitboat (pole-and-line or aku boat), main Hawaiian Islands (MHI) troll and handline, and Northwestern Hawaiian Islands (NWHI) landings. Detailed information on the estimation procedure is available in Ito (1992). Numbers rounded to nearest 100,000. Columns may not add precisely due to rounding.

Interpretation: Total pelagic landings increased by 20%, nominal revenue increased 17%, and adjusted revenue rose by 14%. Almost all species showed an increase in landings, except for mahimahi, which decreased by 27%. Non-tuna PPMUS landings increased 17%, nominal revenu was up by 17%, and adjusted revenue rose 13%. Total tuna landings rose 26%, nominal revenue increased 21%, and adjusted revenue was up by 17%. As in recent years, non-tuna PPMUS landings and revenue exceeded tuna landings and revenue, largely due to the longline fishery.

Table 2. Hawaii commercial pelagic landings and revenue by gear, 1992-93

Gear	Pounds Landed (x 1,000)	Pounds Sold (x 1,000)	Ex-vessel Revenue (x $1,000)	Average Price ($/lb)
		1992		
Baitboat	1,700	1,700	2,400	1.40
Handline	1,900	1,900	3,200	1.70
Longline	21,200	21,200	44,700	2.10
Trolling	2,500	2,100	3,900	1.87
Other	4	2	5	2.06
TOTAL	**27,400**	**27,000**	**54,200**	**2.01**
		1993		
Baitboat	2,100	2,100	2,400	1.13
Handline	2,100	2,100	3,900	1.84
Longline	26,000	26,000	53,300	2.05
Trolling	2,600	2,200	3,800	1.78
Other	5	4	5	1.09
TOTAL	**32,900**	**32,400**	**63,500**	**1.95**

Source and Calculation: NMFS estimates and HDAR commercial catch report data, as in Table 1 notes. Pelagic species only. 1993 data are preliminary. Rounded to nearest 100,000. Columns may not add precisely due to rounding.

Interpretation: Landings by all gear types increased in 1993 while prices decreased. Revenues went up in 1993 except for baitboat (no change) and trolling (down slightly).

Table 3. Hawaii longline landings, catch per unit effort, and revenue, 1992-93

Species	1992 Landings (x 1,000 lb)	1992 CPUE (No. caught per 1000 hooks)	1992 Revenue (x $1,000)	1993 Landings (x 1,000 lb)	1993 CPUE (No. caught per 1000 hooks)	1993 Revenue (x $1,000)
Blue marlin	730	0.39	591	800	0.39	710
Swordfish	12,640	6.36	24,270	13,460	6.11	26,830
Striped marlin	1060	1.37	1360	1,140	1.40	1,400
Other billfish	280	0.48	300	270	0.44	250
Mahimahi	590	4.85	830	270	2.00	390
Wahoo	80	0.21	200	150	0.34	280
Sharks	560	8.12	350	2,590	11.85	2,970
Non-Tuna PPMUS Subtotal	**15,940**	**na**	**27,901**	**18,680**	**na**	**32,830**
Bigeye tuna	3,280	3.74	11,910	4,110	4.21	14,320
Yellowfin tuna	770	0.67	2,310	1,570	1.24	4,280
Albacore	780	1.69	970	1,070	2.33	1,280
Other tuna	100	0.30	680	150	0.41	150
Tunas Subtotal	**4,930**	**6.41**	**15,870**	**6,900**	**na**	**20,030**
Misc. pelagics	370	0.92	600	430	0.96	450
TOTAL	**21,240**	**20.23**	**44,650**	**26,010**	**19.69**	**53,310**

Source and Calculation: NMFS estimates based on NMFS longline logbook data and NMFS/HDAR shoreside monitoring data. 1993 data are preliminary. The numbers may not sum precisely due to rounding.

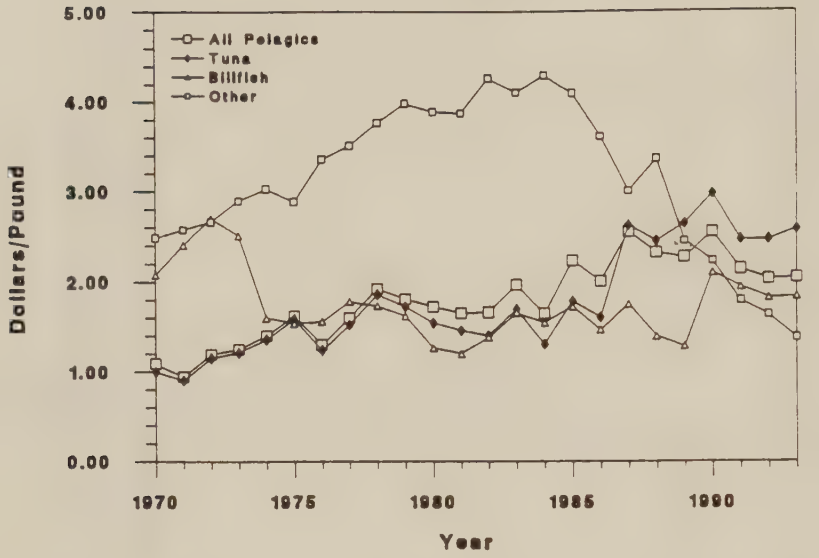
Interpretation: Landings increased 22% and unadjusted revenues rose 19%, but overall catch rate decreased 3%. While landings of most species increased, especially tunas, but mahimahi dropped 54%. Catch rates for non-tuna PPMUS changed relatively little, except mahimahi, but catch rates for tunas rose substantially.

Table 4. Average size of fish (in pounds) by gear type

Year	Non-Tuna PPMUS					Tunas			
	Swordfish	Blue marlin	Striped marlin	Mahimahi	Wahoo	Bigeye	Yellowfin	Albacore	Skipjack
Longline									
1987	129.3	161.4	66.2	21.1	33.3	76.3	81.9	62.3	- -
1988	119.2	157.3	56.9	20.0	31.9	83.2	102.5	59.7	- -
1989	131.1	164.7	61.5	23.0	34.6	77.0	103.7	62.0	- -
1990	147.6	198.4	61.5	18.7	36.0	79.8	121.9	61.2	- -
1991	142.4	172.0	55.8	14.5	31.6	85.5	117.2	53.3	- -
1992	177.9	166.9	69.1	10.9	34.7	76.7	100.5	48.1	- -
1993	166	154	65	13	32	90	96	49	- -
Troll and Handline									
1987	- -	212.1	67.3	18.8	19.5	19.6	27.6	- -	8.9
1988	- -	181.6	60.3	17.2	21.1	58.9	31.5	- -	11.1
1989	- -	185.7	67.9	19.9	20.9	34.0	35.4	- -	13.6
1990	- -	243.3	74.8	19.1	21.9	25.3	51.6	- -	10.6
1991	- -	179.2	60.6	13.5	18.8	20.4	26.0	- -	14.5

Source and Calculation: NMFS estimate from NMFS/HDAR shoreside monitoring program. Average weights are the averages of shoreside monitoring samples. 1993 weights are preliminary estimates. 1992 and 1993 data for troll and handline are not presented because reduced sampling of troll and handline catch from the monitoring program makes those estimates unreliable.

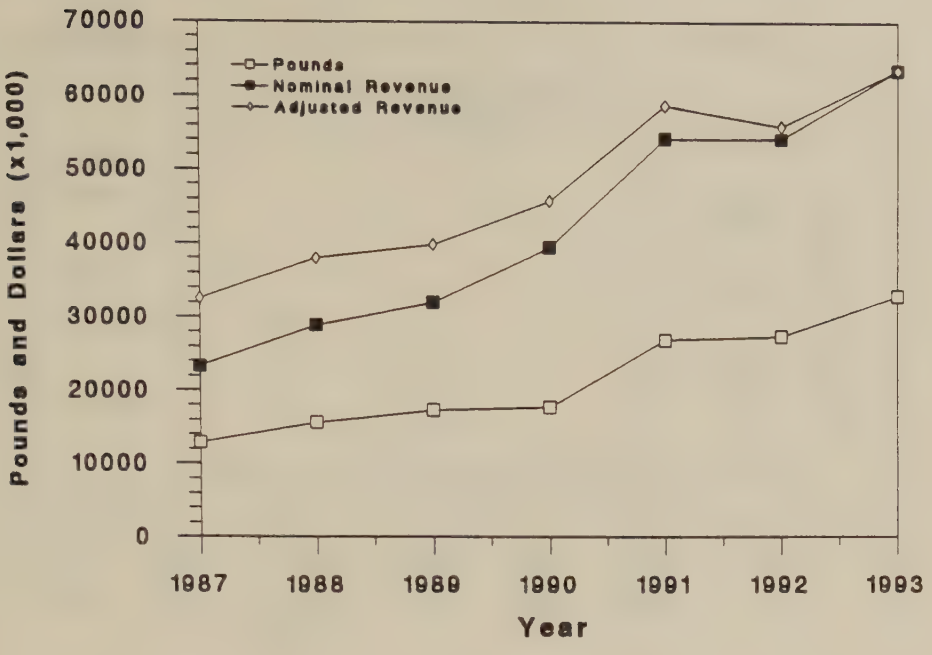
Figure 1. Inflation-adjusted prices of pelagics



Year	All Pelagics	Tuna	Billfish	Other
1970	1.09	1.00	2.08	2.49
1971	0.94	0.90	2.41	2.58
1972	1.19	1.15	2.71	2.67
1973	1.25	1.21	2.52	2.90
1974	1.40	1.36	1.60	3.03
1975	1.62	1.59	1.54	2.89
1976	1.30	1.24	1.56	3.36
1977	1.60	1.52	1.78	3.51
1978	1.92	1.86	1.73	3.77
1979	1.81	1.72	1.62	3.98
1980	1.72	1.54	1.26	3.89
1981	1.65	1.46	1.20	3.87
1982	1.66	1.40	1.38	4.26
1983	1.96	1.69	1.65	4.10
1984	1.64	1.30	1.54	4.29
1985	2.23	1.78	1.72	4.09
1986	2.00	1.60	1.46	3.61
1987	2.55	2.62	1.75	3.00
1988	2.32	2.45	1.39	3.36
1989	2.27	2.64	1.28	2.45
1990	2.55	2.97	2.10	2.23
1991	2.14	2.47	1.94	1.79
1992	2.03	2.47	1.82	1.63
1993	2.04	2.58	1.83	1.37

Source: NMFS estimates from NMFS/HDAR shoreside monitoring program and HDAR commercial catch data.

Figure 2. Hawaii commercial pelagic landings and revenue



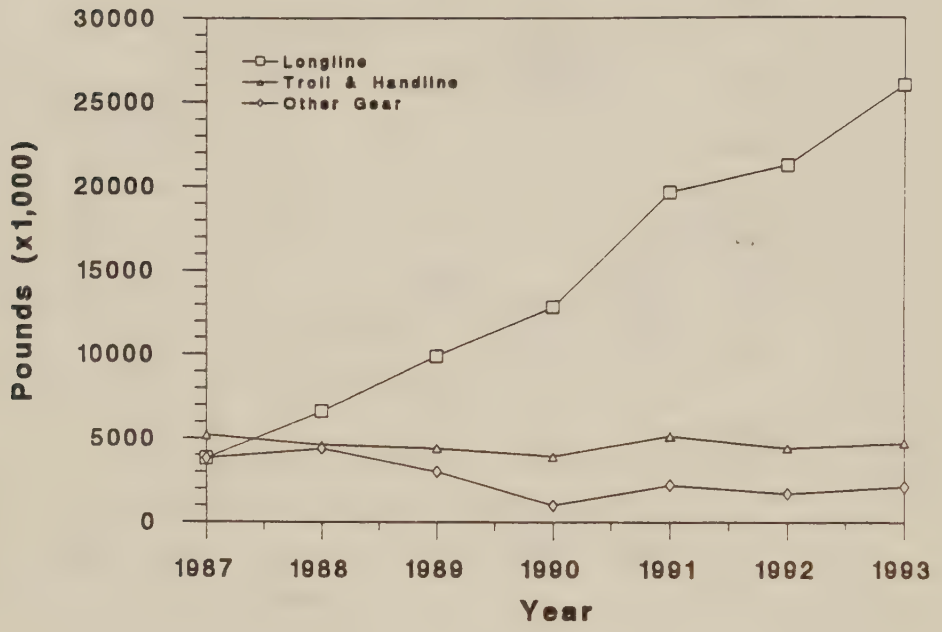
Year	Pounds (x 1,000)	Revenue (x $1,000) Nominal	Adjusted
1987	12,800	23,300	32,500
1988	15,600	28,900	38,000
1989	17,300	32,000	39,800
1990	17,700	39,500	45,800
1991	26,900	54,300	58,700
1992	27,400	54,200	55,900
1993	32,900	63,500	63,500
Mean ±SD	21,514 ±6,933	42,243 ±14,089	47,743 ±10,883

Source and Calculation: Landings and revenue data were collected by NMFS and HDAR. See notes to Table 1 for estimation procedures. Nominal revenue is converted to inflation-adjusted revenue (1993 level) with the Honolulu Consumer Price Index (CPI-U)[6]. Estimates were rounded to nearest 100,000 pounds or dollars. The numbers may not add precisely due to rounding.

Interpretation: Total pelagic harvest increased by 20% in weight and 14% in adjusted revenue from the previous year. However, landings increased 53%, and adjusted revenue increased 33% over the 1987-93 average.

[6] State of Hawaii Data Book 1992: A statistical abstract. Department of Business, Economic Development and Tourism, Table 411, page 369. 1993 CPI-U obtained via personal communication (DBEDT 1994).

Figure 3. Hawaii total commercial pelagic landings by gear type

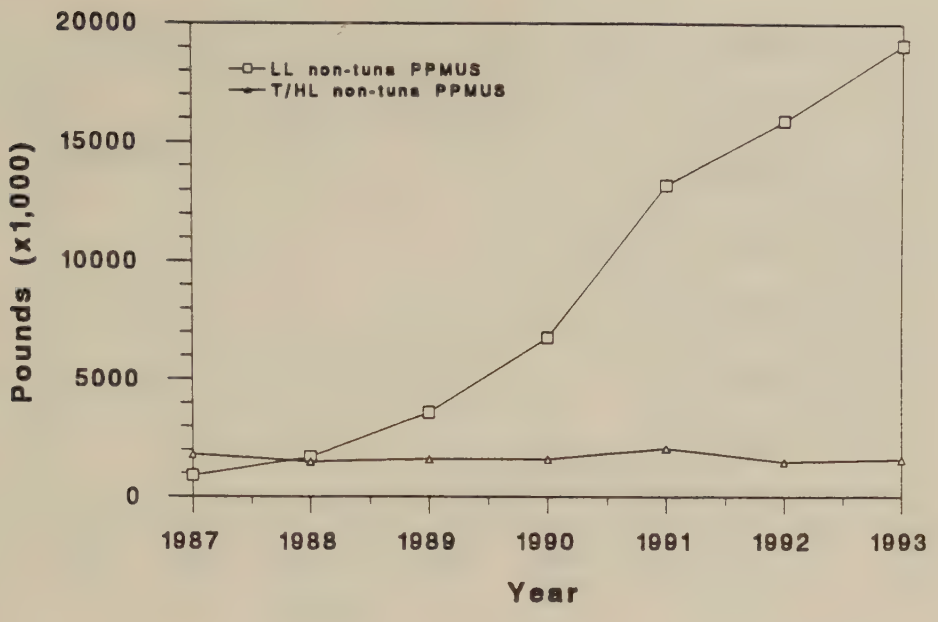


Year	Pounds landed (x 1,000)		
	Longline	Troll & Handline	Other Gear
1987	3,800	5,200	3,800
1988	6,600	4,600	4,400
1989	9,900	4,400	3,000
1990	12,800	3,900	1,000
1991	19,600	5,100	2,200
1992	21,200	4,400	1,700
1993	26,000	4,700	2,100
Mean ±SD	14,270 ±7594	4,614 ±412	2,600 ±1,110

Source and Calculation: Landings data were collected by the NMFS and HDAR. See notes to Table 1 for estimation procedures. Estimates were rounded to the nearest 100,000 pounds. The numbers may not add precisely due to rounding.

Interpretation: Longline landings increased by 23% in 1993, greater than the relative increase in 1992. Some of the increase is due to the higher estimated shark landings. Troll and handline landings increased 7% from 1992 and were on the 1987-93 average. Landings of other gear (primarily baitboat) increased 24%, but were not significantly different from the long-term average. The long-term decline in the baitboat fishery has apparently flattened out for the time being.

Figure 4. Hawaii non-tuna commercial PPMUS landings by gear type

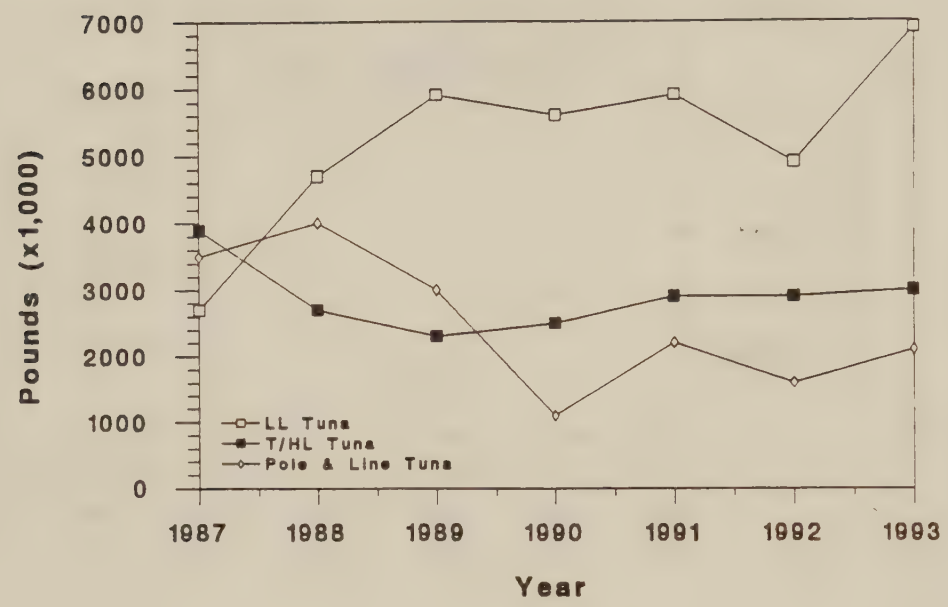


Year	Pounds Landed (x 1,000)	
	Longline	Troll & Handline
1987	900	1,800
1988	1,700	1,500
1989	3,600	1,600
1990	6,800	1,600
1991	13,200	2,100
1992	15,900	1,500
1993	19,100	1,600
Average	8,743 ±6,758	1,671 ±198

Source and Calculation: Landings data were collected by the NMFS and HDAR market monitoring program, and the HDAR commercial catch reporting system (for troll and handline). See notes to Table 1 for estimation procedures. Estimates were rounded to the nearest 100,000 pounds. The numbers may not add precisely due to rounding.

Interpretation: Longline landings of non-tuna PPMUS increased 20%, while troll and handline landings remained about the same and near the long-term average. While swordfish contributed to the increase in longline landings, most of the difference was due to higher tuna and shark landings.

Figure 5. Hawaii commercial tuna landings by gear type

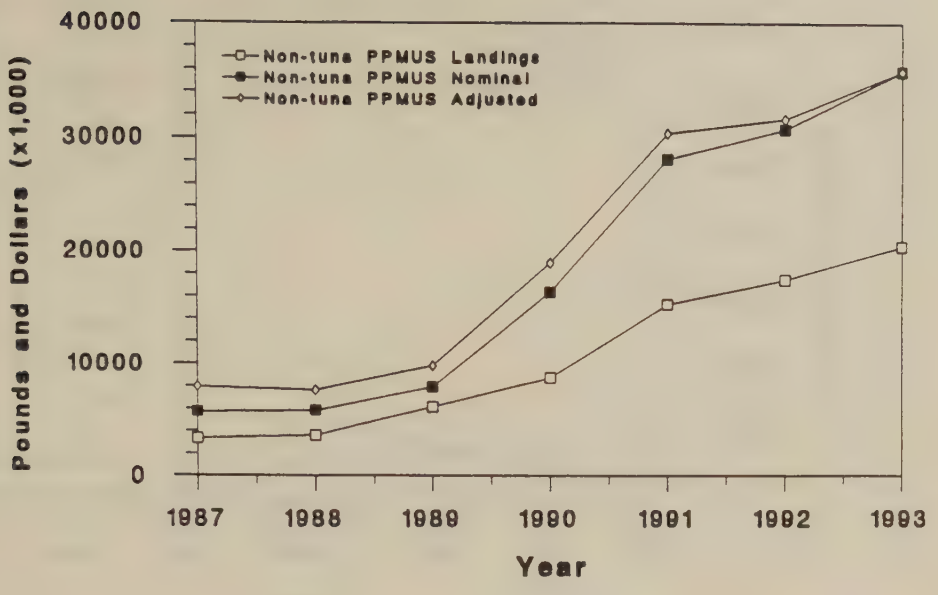


Year	Pounds Landed (x 1,000)		
	Longline	Baitboat	Troll & Handline
1987	2,700	3,600	3,900
1988	4,700	4,300	2,700
1989	5,900	2,800	2,300
1990	5,600	1,000	2,500
1991	5,900	2,200	2,900
1992	4,900	1,500	2,900
1993	6,900	2,100	3,000
Mean ±SD	5,229 ±1,231	2,500 ±1,072	2,886 ±473

Source and Calculation: Landings data were collected by the NMFS and HDAR shoreside monitoring program, and the HDAR commercial catch reporting system (for troll and handline). See notes to Table 1 for estimation procedures. Estimates were rounded to the nearest 100,000 pounds. The numbers may not add precisely due to rounding.

Interpretation: Longline landings of tuna reached a record high in 1993, baitboat increased by 40%, and troll and handline landings increased very slightly.

Figure 6. Hawaii non-tuna PPMUS landings and revenue

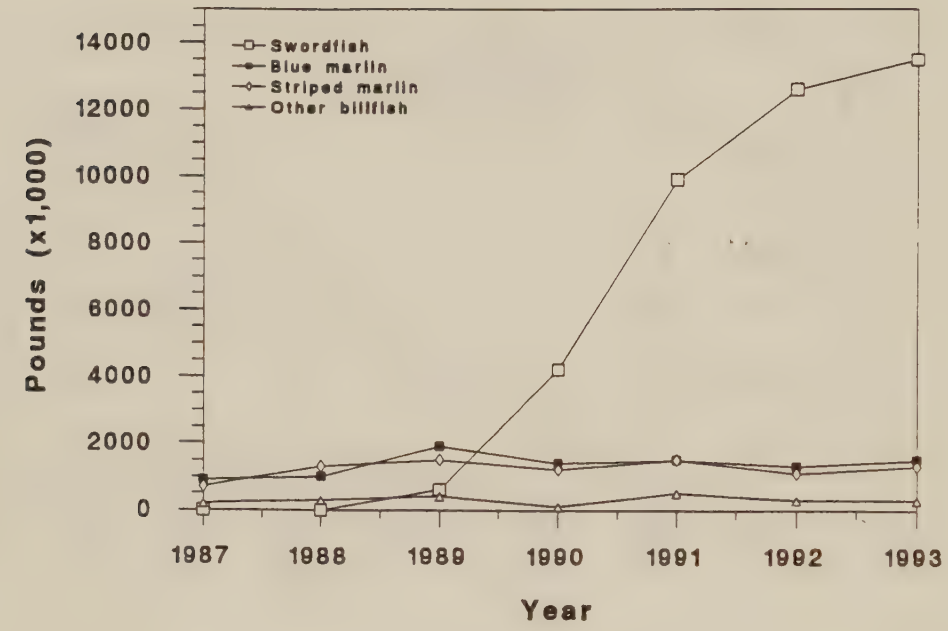


Year	Pounds (x 1,000)	Revenue (x $1,000) Nominal	Revenue (x $1,000) Adjusted
1987	3,300	5,700	7,900
1988	3,600	5,800	7,600
1989	6,100	7,900	9,800
1990	8,800	16,400	19,000
1991	15,300	28,100	30,400
1992	17,500	30,700	31,700
1993	20,400	35,800	35,800
Mean ±SD	10,714 ±6,452	18,629 ±11,845	17,733 ±10,161

Source and Calculation: Landings data were collected by the NMFS and HDAR shoreside monitoring program, and the HDAR commercial catch reporting system (for troll and handline). See notes to Table 1 for estimation procedures. Estimates were rounded to the nearest 100,000 pounds. The numbers may not add precisely due to rounding.

Interpretation: Total non-tuna PPMUS landings increased moderately (+17%), as did nominal revenue (+17%) and adjusted revenue (+13%). All 1993 figures were almost double the 1987-93 averages.

Figure 7. Species composition of Hawaii commercial billfish landings

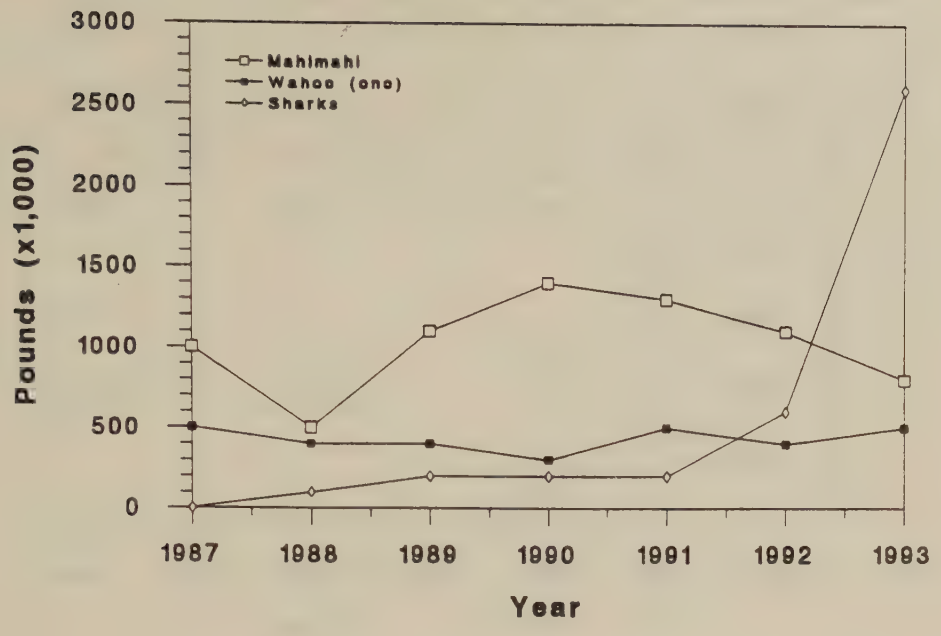


Year	Pounds Landed (x 1,000)			
	Swordfish	Blue marlin	Striped marlin	Other billfish
1987	0	900	700	200
1988	0	1,000	1,300	300
1989	600	1,900	1,500	400
1990	4,200	1,400	1,200	100
1991	9,900	1,500	1,500	500
1992	12,600	1,300	1,100	300
1993	13,500	1,500	1,300	300
Mean ±SD	5,829 ±5,596	1,357 ±311	1,229 ±255	300 ±120

Source and Calculation: Landings data were collected by the NMFS and HDAR shoreside monitoring program, and the HDAR commercial catch reporting system (for troll and handline). See notes to Table 1 for estimation procedures. Estimates were rounded to the nearest 100,000 pounds. The numbers may not add precisely due to rounding.

Interpretation: Swordfish landings increased 7% from 1992, compared to the 136% increase from 1990 to 1991, and 27% increase from 1991 to 1992. Blue marlin landings remained at about the same level and near the long-term average. Striped marlin landings increased 18% bu was not significantly different from the 1987-93 average. Other billfish landings returned to the 1987-93 average.

Figure 8. Hawaii commercial landings -- mahimahi, wahoo, and sharks

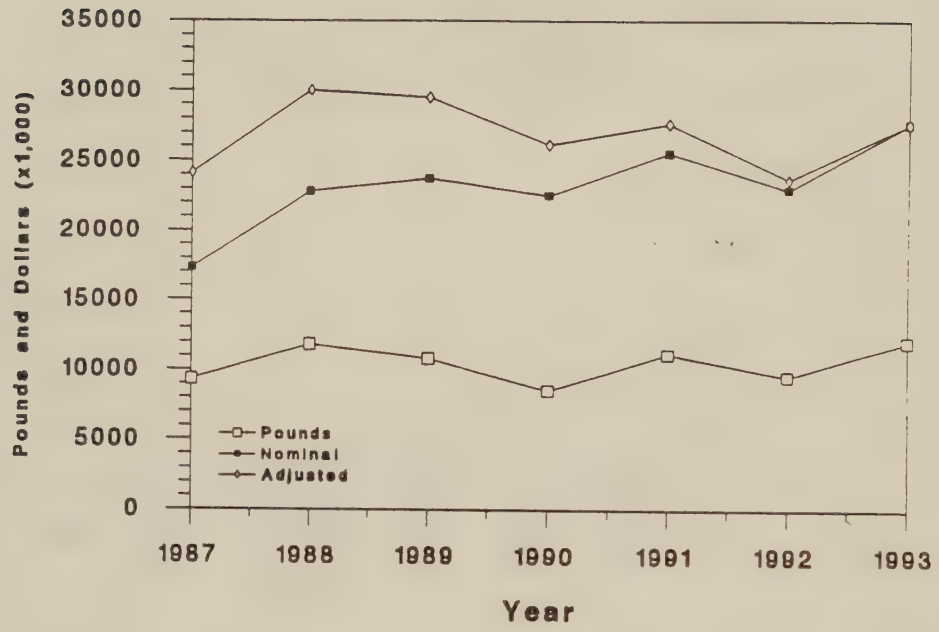


Year	Pounds (x 1,000)		
	Mahimahi	Wahoo	Sharks
1987	1,000	500	0
1988	500	400	100
1989	1,100	400	200
1990	1,400	300	200
1991	1,300	500	200
1992	1,100	400	600
1993	800	500	2,600
Mean ±SD	1,028 ±281	429 ±70	557 ±852

Source and Calculation: Landings data were collected by the NMFS and HDAR shoreside monitoring program, and the HDAR commercial catch reporting system (for troll and handline). See notes to Table 1 for estimation procedures. Estimates were rounded to the nearest 100,000 pounds. The numbers may not add precisely due to rounding.

Interpretation: Mahimahi landings continued to decrease (-27% from 1992) and was a little below the 1987-93 average. Wahoo landings were about the same as 1992, while shark landings increased dramatically. The increased shark landings were due to a new estimate of whole weights represented by shark fin landings.

Figure 9. Hawaii tuna landings and revenue

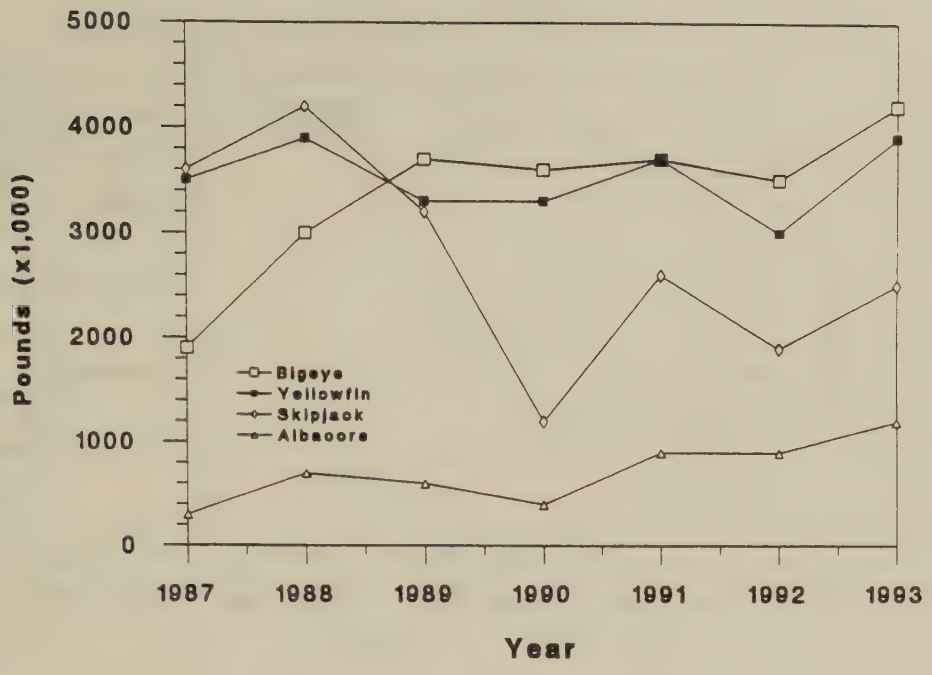


Year	Pounds (x 1,000)	Revenue (x $1,000)	
		Nominal	Adjusted
1987	9,300	17,300	23,400
1988	11,800	22,800	29,100
1989	10,800	23,700	28,600
1990	8,500	22,500	25,300
1991	11,100	25,500	26,700
1992	9,500	22,900	23,600
1993	12,000	27,600	27,600
Mean ±SD	10,429 ±1,242	23,186 ±2,939	26,229 ±2,265

Source and Calculation: Landings data were collected by the NMFS and HDAR shoreside monitoring program, and the HDAR commercial catch reporting system (for troll and handline). See notes to Table 1 for estimation procedures. Estimates were rounded to the nearest 100,000 pounds. The numbers may not add precisely due to rounding.

Interpretation: Total tuna landings increased 26%, and was above the 1987-93 average. Nominal (+21%) and adjusted revenue (+17%) also increased from the previous year.

Figure 10. Species composition of Hawaii commercial tuna landings

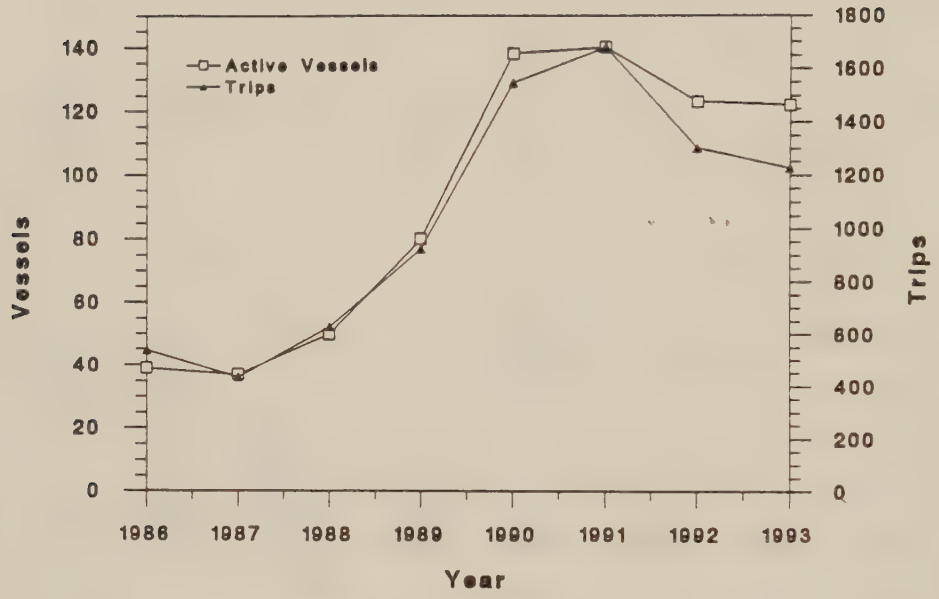


	Pounds Landed (x 1,000)			
Year	Bigeye	Yellowfin	Skipjack	Albacore
1987	1,900	3,500	3,600	300
1988	3,000	3,900	4,200	700
1989	3,700	3,300	3,200	600
1990	3,600	3,300	1,200	400
1991	3,700	3,700	2,600	900
1992	3,500	3,000	1,900	900
1993	4,200	3,900	2,500	1,200
Mean ±SD	3,371 ±684	3,514 ±314	2,743 ±944	714 ±290

Source and Calculation: Landings data were collected by the NMFS and HDAR shoreside monitoring program, and the HDAR commercial catch reporting system (for troll and handline). See notes to Table 1 for estimation procedures. Estimates were rounded to the nearest 100,000 pounds. The numbers may not add precisely due to rounding.

Interpretation: Landings of all species increased substantially from 1992. Albacore (+33%) reached a new peak. Yellowfin increased 30%, bigeye by 20%, and skipjack increased by 32%. Yellowfin, bigeye, and albacore landings were higher than the 1987-93 average, but skipjack was below average.

Figure 11. Hawaii longline vessel activity

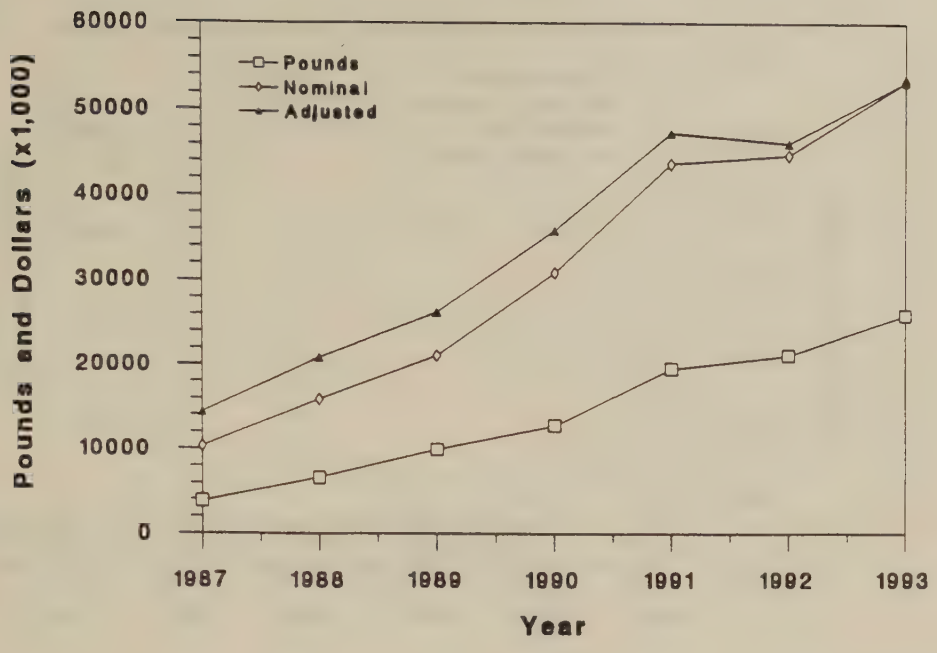


Year	Active Vessels	Trips
1986	39	537
1987	37	435
1988	50	627
1989	80	923
1990	138	1,546
1991	140	1,681
1992	123	1,299
1993	122	1,228

Source and Calculation: Data were collected by the NMFS longline logbook program and fr the NMFS/HDAR shoreside monitoring program. Active vessels were defined as those making least one longline landing in 1993.

Interpretation: The number of active longline vessels was almost the same as 1992, but the number of trips decreased by 5%. The decrease in number of trips could be due to increased targeting of swordfish by the fleet, which might result in vessels taking fewer, longer trips.

Figure 12. Hawaii longline landings and revenue

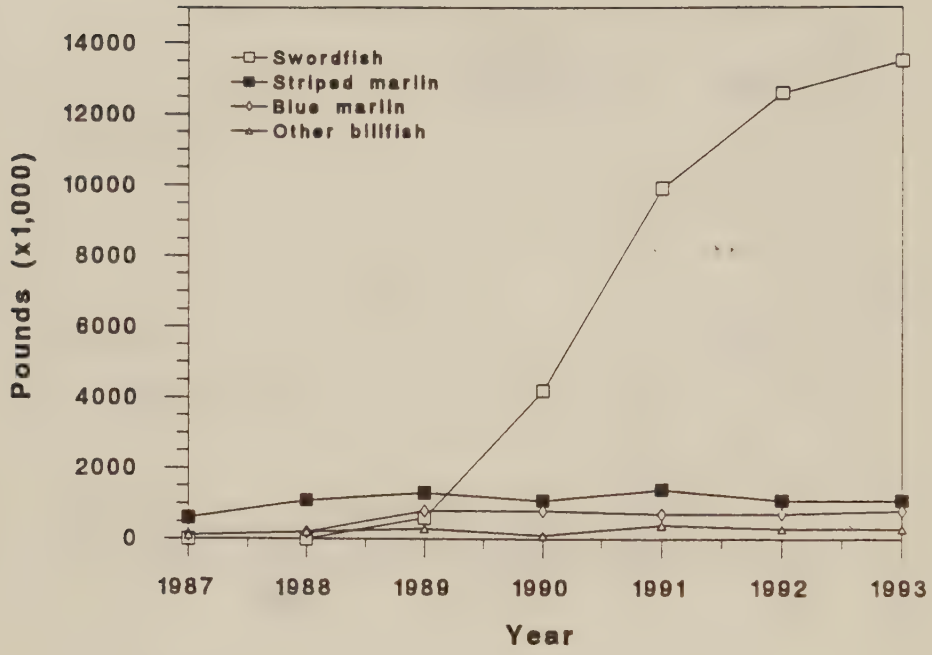


Year	Pounds (x 1,000)	Revenue (x $1,000) Nominal	Adjusted
1987	3,800	10,300	14,400
1988	6,600	15,900	20,900
1989	9,900	21,100	26,200
1990	12,800	30,900	35,800
1991	19,600	43,700	47,300
1992	21,200	44,700	46,100
1993	26,000	53,300	53,300
Mean ±SD	14,273 ±7,597	31,416 ±15,119	34,886 ±13,690

Source and Calculation: Landings data were collected by the NMFS and HDAR shoreside monitoring program and NMFS longline logbook program. See notes to Table 1 for estimation procedures. Estimates were rounded to the nearest 100,000 pounds. The numbers may not add precisely due to rounding.

Interpretation: Longline landings increased 23% from 1992 to 1993, compared to the slight 8% increase from 1991 to 1992. Nominal revenue (+19%) and adjusted revenue (+16%) also increased substantially.

Figure 13. Hawaii longline landings -- billfish

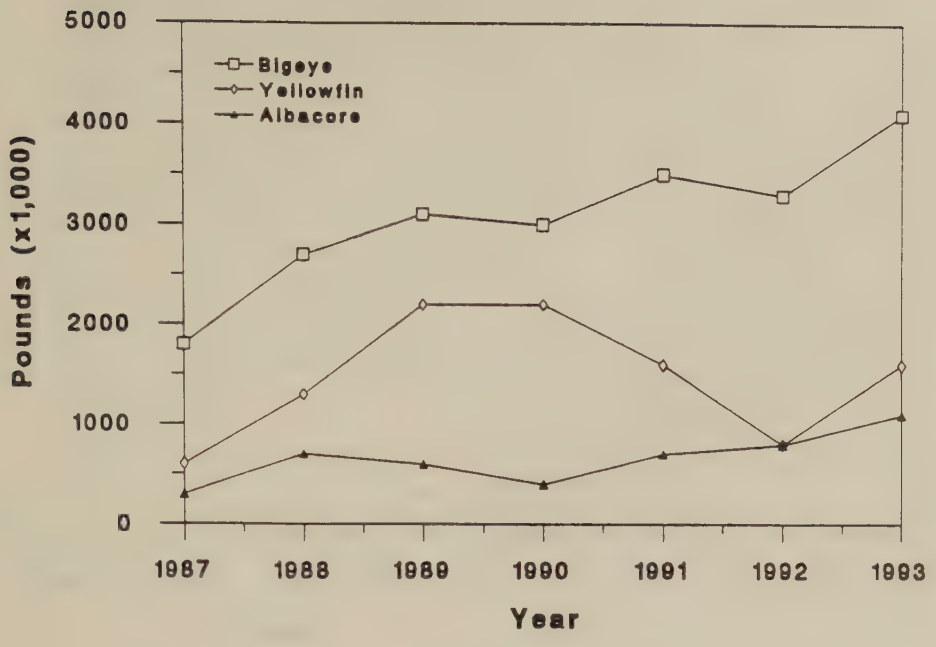


	Pounds Landed (x 1,000)			
Year	Swordfish	Striped marlin	Blue marlin	Other billfish
1987	0	600	100	100
1988	0	1,100	200	200
1989	600	1,300	800	300
1990	4,200	1,100	800	100
1991	9,900	1,400	700	400
1992	12,600	1,100	700	200
1993	13,500	1,100	800	300
Mean ±SD	5,829 ±5,596	1,100 ±233	586 ±280	229 ±103

Source and Calculation: Landings data were collected by the NMFS and HDAR shoreside monitoring program and NMFS longline logbook program. See notes to Table 1 for estimation procedures. Estimates were rounded to the nearest 100,000 pounds. The numbers may not add precisely due to rounding.

Interpretation: Landings of swordfish increased a slight 7% from 1992, compared to the 27% increase from 1991 to 1992. Blue marlin and other billfish landings showed little change.

Figure 14. Hawaii longline landings -- tunas

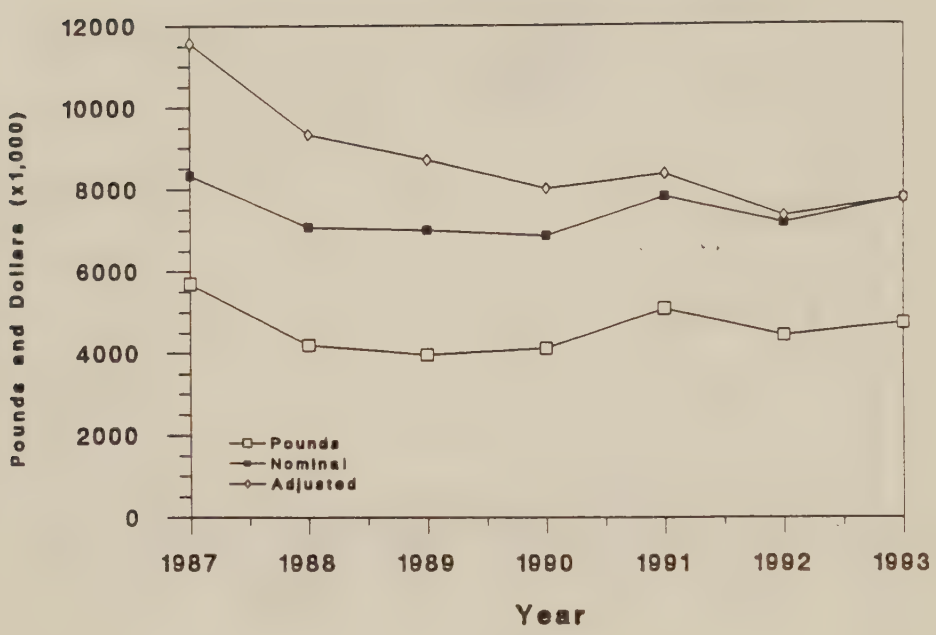


Year	Pounds Landed (x 1,000)		
	Bigeye	Yellowfin	Albacore
1987	1,800	600	300
1988	2,700	1,300	700
1989	3,100	2,200	600
1990	3,000	2,200	400
1991	3,500	1,600	700
1992	3,300	800	800
1993	4,100	1,600	1,100
Mean ±SD	3,071 ±661	1,471 ±577	657 ±244

Source and Calculation: Landings data were collected by the NMFS and HDAR shoreside monitoring program and NMFS longline logbook program. See notes to Table 1 for estimation procedures. Estimates were rounded to the nearest 100,000 pounds. The numbers may not add precisely due to rounding.

Interpretation: All longline tuna landings increased substantially in 1993. Bigeye landings rose 24%, albacore rose 38%, and yellowfin landings doubled from 1992.

Figure 15. Hawaii troll and handline landings and revenue

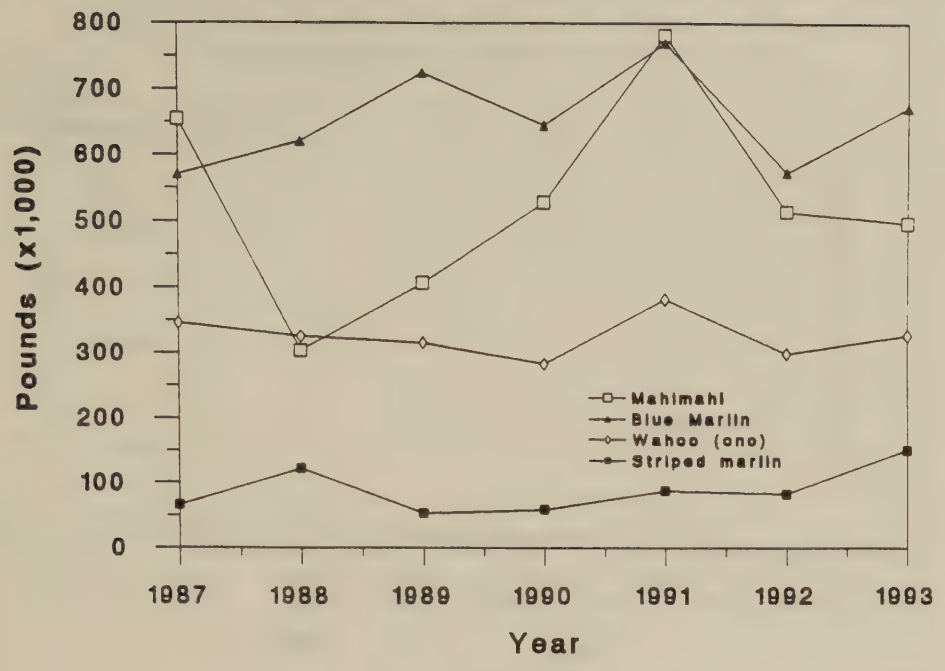


Year	Pounds (x 1,000)	Revenues (x $1,000) Nominal	Adjusted
1987	5,696	8,340	11,565
1988	4,194	7,074	9,340
1989	3,958	7,000	8,708
1990	4,111	6,859	7,999
1991	5,066	7,796	8,348
1992	4,412	7,149	7,329
1993	4,710	7,755	7,755
Mean ±SD	4,592 ±571	7,245 ±505	8,721 ±1,309

Source and Calculation: Landings data were collected by the HDAR commercial catch reporting system.

Interpretation: Troll and handline landings (+6%), nominal revenue (+8%), and adjusted revenue (+6%) increased slightly from 1992 and were not significantly different from the long term means.

Figure 16. Hawaii commercial troll and handline landings -- non-tuna PPMUS

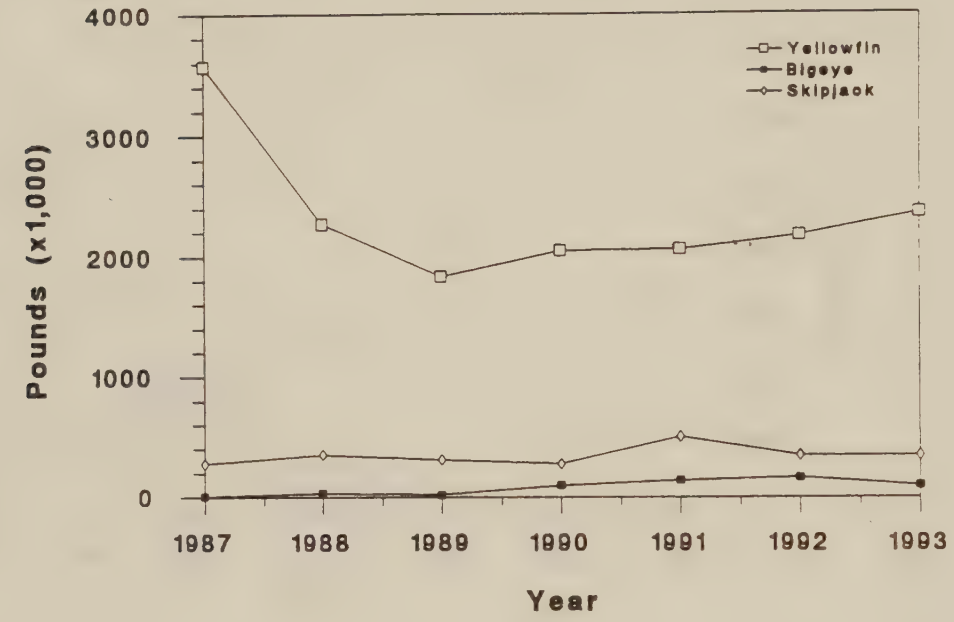


Year	Pounds Landed (x 1,000)			
	Mahimahi	Blue marlin	Wahoo	Striped marlin
1987	655	571	346	66
1988	304	621	326	122
1989	407	724	316	53
1990	529	645	284	59
1991	781	769	383	88
1992	515	574	300	83
1993	497	672	328	151
Mean ±SD	527 ±144	654 ±69	326 ±28	89 ±23

Source and Calculation: Landings data were collected by the HDAR commercial catch reporting system.

Interpretation: Mahimahi landings (-3%) continued to decline from the peak in 1991 but was not significantly lower than the long-term average. Blue marlin rose by 17%. Wahoo landings remained about the same, showing little variation over the same period. Striped marlin landings increased dramatically (+82%), setting a new peak and rising well above the long-term average.

Figure 17. Hawaii commercial troll and handline landings -- tunas

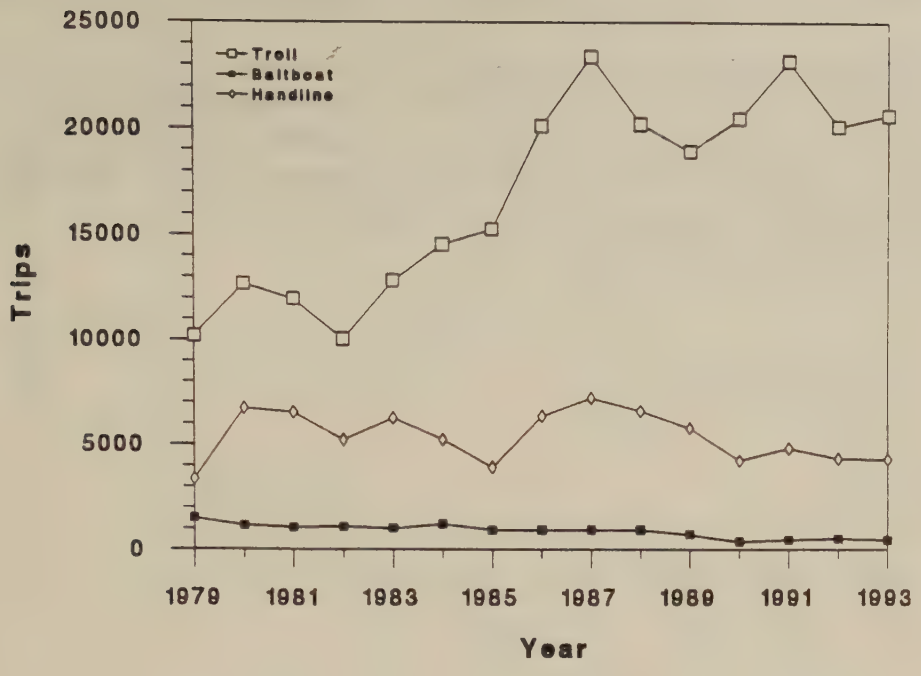


Year	Pounds Landed (x 1,000)		
	Yellowfin	Bigeye	Skipjack
1987	3,575	6	275
1988	2,275	31	355
1989	1,837	19	313
1990	2,054	97	275
1991	2,066	142	504
1992	2,182	164	347
1993	2,367	98	345
Mean ±SD	2,337 ±530	80 ±57	345 ±72

Source and Calculation: Landings data were collected by the HDAR commercial catch reporting system..

Interpretation: In 1993, troll and handline landings of yellowfin tuna were slightly higher (+8%) than in 1992. Bigeye tuna landings were substantially lower (-40%), but still within the range of the long-term average. Skipjack landings were almost identical to 1992, and matched the long-term average.

Figure 18. Hawaii commercial pelagic trips by non-longline gear



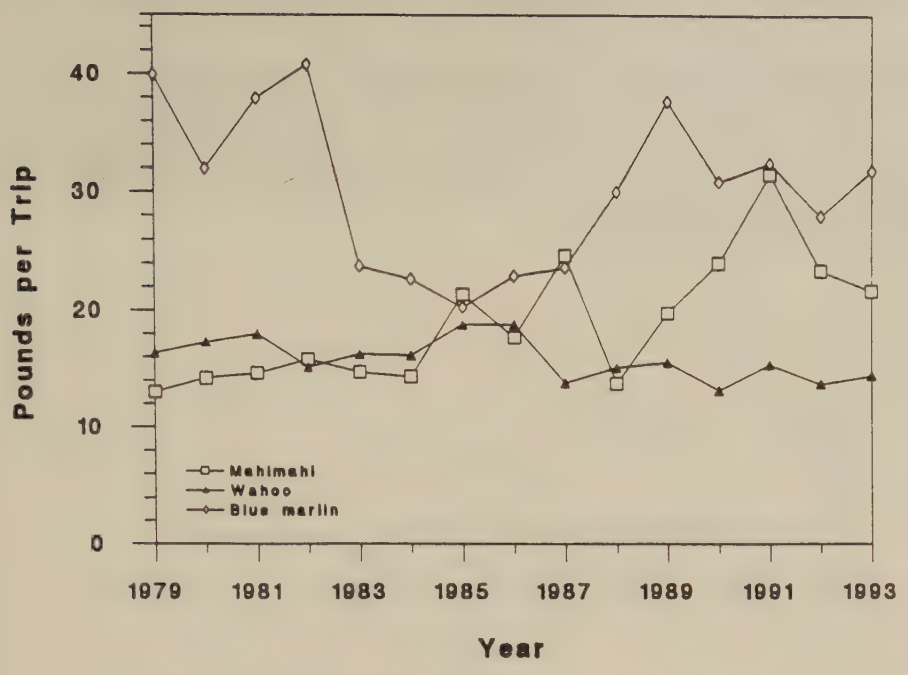
	Number of Trips		
Year	Troll	Baitboat	Handline
1979	10,185	1,495	3,346
1980	12,692	1,149	6,746
1981	11,975	1,059	6,562
1982	10,039	1,067	5,219
1983	12,842	1,014	6,275
1984	14,556	1,232	5,248
1985	15,291	924	3,929
1986	20,139	941	6,412
1987	23,391	938	7,263
1988	20,202	941	6,647
1989	18,924	723	5,834
1990	20,468	378	4,261
1991	23,184	463	4,861
1992	20,109	510	4,374
1993	20,647	477	4,343
Mean ±SD	16,976 ±4,493	887 ±308	5,421 ±1,165

Source and Calculation: Division of Aquatic Resources's Commercial Catch Reports for calendar years. Each day fished for a pelagic species by a fisherman is one trip, that is, daily trips were assumed. All handline gear trips were combined into the handline trip total. Total handline trips may be inaccurate for recent years due to multi-day trips taken by fishermen

working offshore seamounts or weather buoys. Unsuccessful (no-catch) trips were not included such data generally have not been reported by fishermen and were not processed prior to 1989.

Interpretation: Reported trolling trips have doubled since 1979, with a rapid increase in the mid-1980s. However, the number has changed relatively little from 1986 on, averaging 20,883 ±1,469 (1986-93). Baitboat trips have decreased by about 68% from 1979, beginning at the time the Honolulu tuna cannery closed in 1984. Combined handline trips show no particular trend, with peaks in 1980, 1983, and 1987, but were below the long-term average in 1993.

Figure 19. Commercial trolling catch per trip -- mahimahi, wahoo and blue marlin



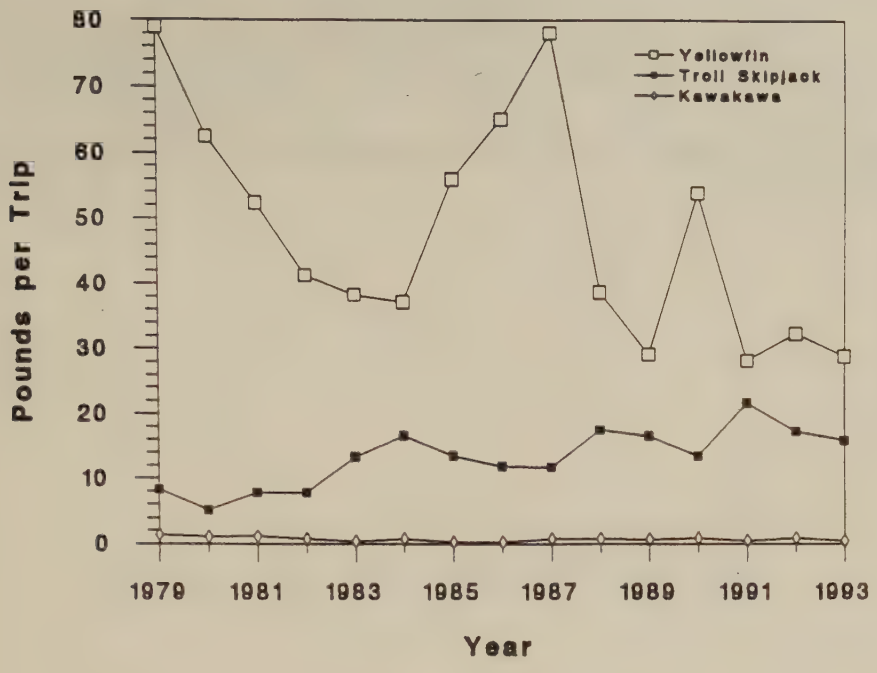
	Pounds Caught per Trolling Trip		
Year	Mahimahi	Wahoo	Blue Marlin
1979	13.0	16.3	39.9
1980	14.2	17.3	32.0
1981	14.6	18.0	37.9
1982	15.8	15.1	40.8
1983	14.7	16.3	23.8
1984	14.3	16.1	22.7
1985	21.3	18.8	20.3
1986	17.7	18.8	22.9
1987	24.7	13.8	23.7
1988	13.8	15.1	30.1
1989	19.8	15.6	37.7
1990	24.0	13.2	30.9
1991	31.5	15.4	32.5
1992	23.4	13.7	28.0
1993	21.6	14.5	31.8
Mean ±SD	19.0 ±5.2	15.9 ±1.7	30.3 ±6.5

Source and Calculation: Division of Aquatic Resources's Commercial Catch Reports for calendar years. Estimated catch per trip (CPT) was calculated by dividing the annual troll landings of each major species by the annual number of troll trips that caught any PPMUS.

Daily trips were assumed. Unsuccessful (no-catch) trips were not included; such data generally have not been reported by fishermen and were not processed prior to 1989.

Interpretation: Blue marlin CPT showed a broad depression from 1983 to 1987, but rose rapidly in 1988-89 to pre-1983 levels. The CPT dropped in 1990-93, but still remained higher than in 1983-87. Except for a slight rise in 1985-1986, wahoo CPT remained nearly constant over the entire period. Mahimahi CPT decreased from a record peak in 1991, but remained slightly above the long-term average.

Figure 20. Commercial trolling catch per trip -- yellowfin, skipjack and kawakawa

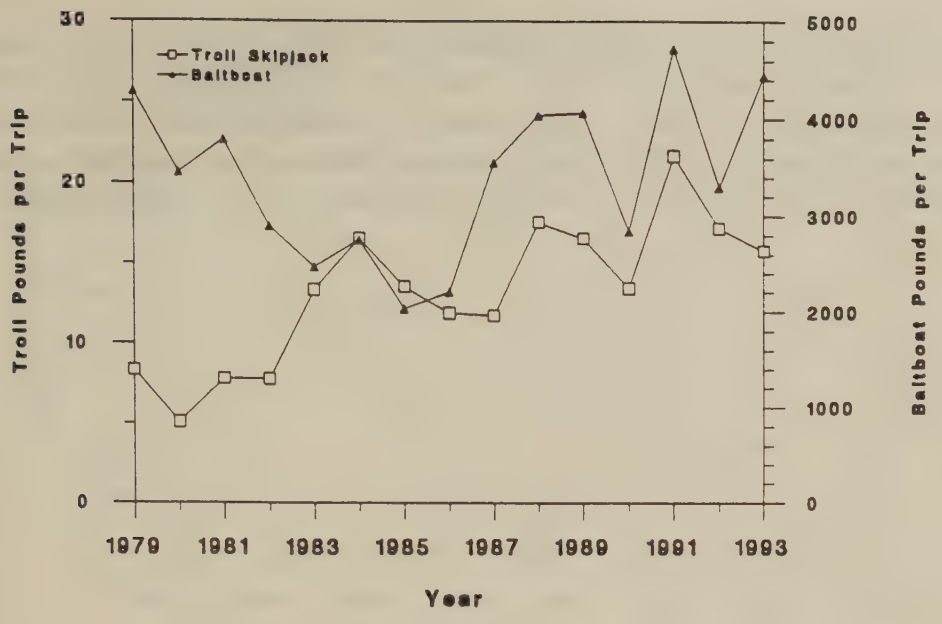


	Pounds Caught per Trolling Trip		
Year	Yellowfin	Skipjack	Kawakawa
1979	79.0	8.3	1.4
1980	62.5	5.1	1.0
1981	52.5	7.8	1.1
1982	41.3	7.8	0.7
1983	38.3	13.4	0.3
1984	37.2	16.6	0.8
1985	55.9	13.6	0.3
1986	65.1	11.9	0.3
1987	78.1	11.8	0.8
1988	38.7	17.6	0.8
1989	29.2	16.6	0.7
1990	53.9	13.4	0.8
1991	28.2	21.7	0.5
1992	32.3	17.2	0.8
1993	28.9	15.8	0.4
Mean ±SD	48.1 ±16.7	13.2 ±4.4	0.7 ±0.3

Source and Calculation: Division of Aquatic Resources's Commercial Catch Reports for calendar years. Estimated catch per trip (CPT) was calculated by dividing the annual troll landings of each major species by the annual number of troll trips that caught any PPMUS. Daily trips were assumed. Unsuccessful (no-catch) trips were not included; such data generally have not been reported by fishermen and were not processed prior to 1989.

Interpretation: Yellowfin CPT has fluctuated widely, decreasing sharply from 1979 to 1984, rising steeply until 1987, and decreasing to a record low in 1991. The 1993 CPT decreased slightly from 1992 and remained below the long-term average. Skipjack CPT has shown a generally rising trend for the entire period, but the 1993 CPT declined slightly from 1992 and was near the long-term average. Kawakawa CPT declined about 50% but remains near the long term average. Interestingly, the low points in yellowfin CPT seems to correspond roughly with peaks in skipjack CPT.

Figure 21. Commercial catch per trip for skipjack, troll and baitboat



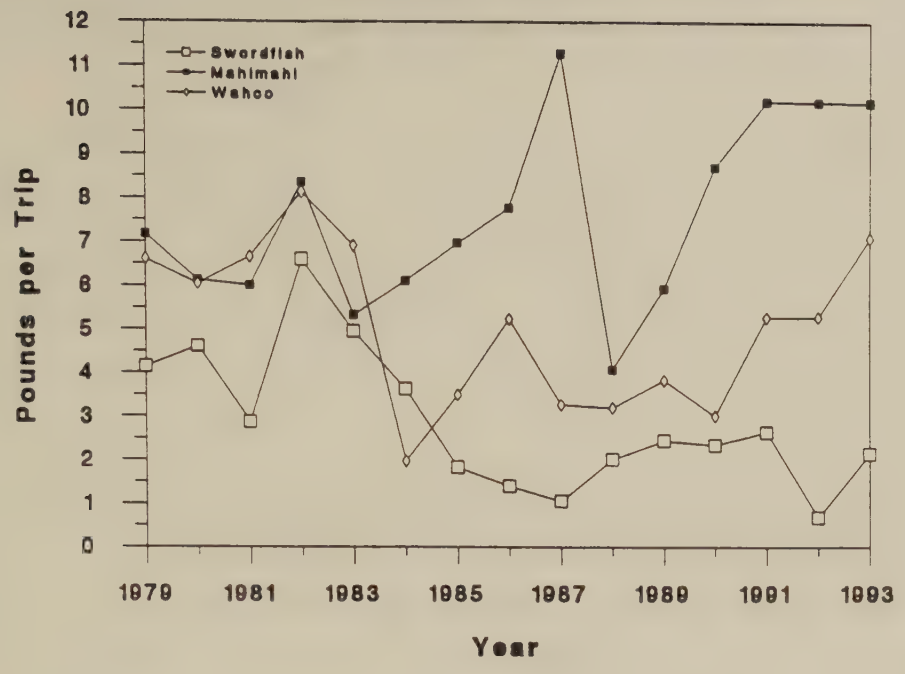
	Pounds Skipjack Caught	
Year	Troll	Baitboat
1979	8.3	4278
1980	5.1	3447
1981	7.8	3786
1982	7.8	2892
1983	13.4	2468
1984	16.6	2748
1985	13.6	2031
1986	11.9	2206
1987	11.8	3548
1988	17.6	4036
1989	16.6	4061
1990	13.4	2840
1991	21.7	4722
1992	17.2	3297
1993	15.8	4447
Mean ±SD	13.2 ±4.4	3387 ±808

Source and Calculation: Division of Aquatic Resources Commercial Catch Reports for calendar years. Estimated catch per trip (CPT) was calculated by dividing the annual troll or baitboat landings of each major species by the annual number of troll or baitboat trips that caught any PPMUS. Daily trips were assumed. Unsuccessful (no-catch) trips were not included; such data

generally have not been reported by fishermen and were not processed prior to 1989. Troll skipjack data do not include skipjack used as live bait.

Interpretation: There was a broad depression in baitboat catch per trip during the early 1980s dip in 1990, but a record high in 1991. The 1993 CPT is second only to 1991. Troll CPT also reached a record high in 1991. The similarity in trends between troll and baitboat CPTs from 1986 on may be due to the dramatically reduced baitboat fleet working mainly around Oahu, where most of the trolling fleet is located. However, in 1993, while baitboat CPT rose, troll CP fell.

Figure 22. Combined commercial handline catch per trip -- swordfish, mahimahi, wahoo, and blue marlin

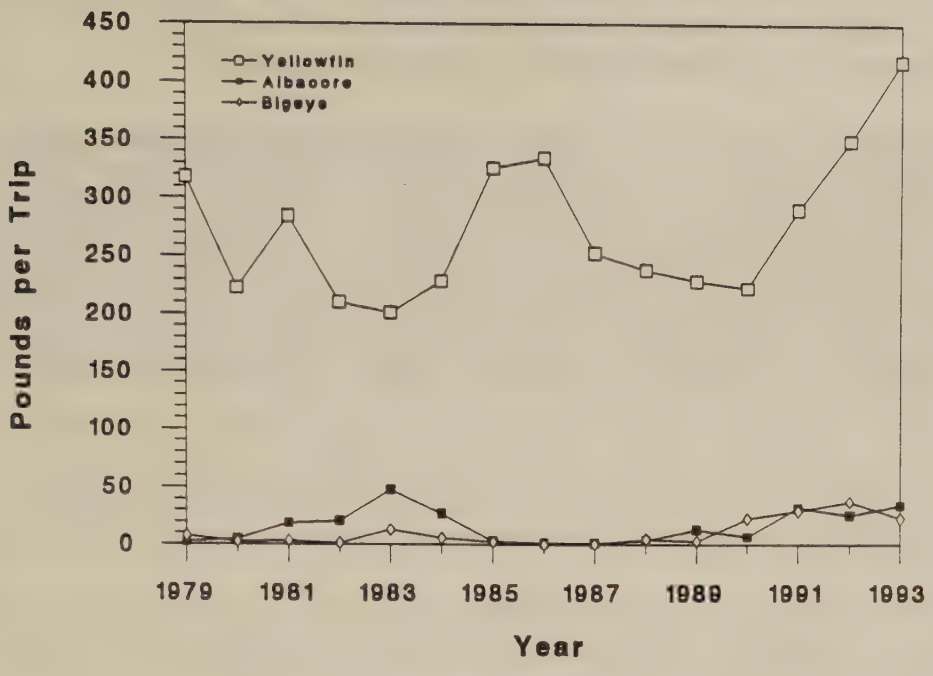


	Combined Handline Catch per Trip (lb)			
Year	Swordfish	Mahimahi	Wahoo	Blue Marlin
1979	4.1	7.2	6.6	4.5
1980	4.6	6.1	6.0	4.0
1981	2.9	6.0	6.7	3.1
1982	6.6	8.4	8.1	5.9
1983	5.0	5.3	6.9	4.2
1984	3.6	6.1	2.0	2.3
1985	1.8	7.0	3.5	2.3
1986	1.4	7.8	5.2	4.1
1987	1.1	11.3	3.3	2.5
1988	2.0	4.1	3.2	2.3
1989	2.4	6.0	3.8	2.4
1990	2.3	8.7	3.0	3.0
1991	2.7	10.2	5.3	3.4
1992	0.7	10.2	5.3	2.7
1993	2.0	11.4	6.6	3.5
Mean ±SD	2.9 ±1.6	7.7 ±2.2	5.0 ±1.7	3.3 ±1.0

Source and Calculation: Division of Aquatic Resources's Commercial Catch Reports for calendar years. Estimated catch per trip (CPT) calculated by dividing the annual handline landings of each major species by the annual number of handline trips that caught any PPMUS. Daily trips were assumed. Unsuccessful (no-catch) trips were not included; such data generally have not been reported by fishermen and were not processed prior to 1989. Only major non-tuna PPMUS caught by handline are shown here.

Interpretation: Except for swordfish, the three major handline non-tuna PPMUS show peaks i CPT in 1982 and in 1986 or 1987. Mahimahi CPT rises to a record peak in 1987, drops to a new low in 1988, then rises to a peak in 1991 almost matching 1987. The high mahimahi CPT continued for 1992-93. The CPTs for swordfish, wahoo, and blue marlin increased from 1992.

Figure 23. Combined commercial handline catch per trip -- yellowfin, albacore and bigeye tunas



Year	Combined Handline Catch per Trip (lb)		
	Yellowfin	Albacore	Bigeye
1979	318.1	2.6	7.8
1980	222.4	5.0	2.3
1981	284.5	18.6	3.3
1982	210.5	20.5	1.6
1983	201.2	47.6	13.1
1984	228.6	26.7	5.6
1985	326.0	3.1	2.6
1986	334.9	1.8	0.4
1987	252.9	1.8	0.9
1988	238.4	3.7	4.9
1989	229.2	13.4	3.3
1990	223.2	7.0	22.7
1991	290.8	32.3	29.2
1992	350.2	25.8	37.5
1993	407.7	35.1	21.1
Mean ±SD	281.2 ±56.2	16.3 ±14.1	10.4 ±11.3

Source and Calculation: Division of Aquatic Resources's Commercial Catch Reports for calendar years. Estimated catch per trip (CPT) calculated by dividing the annual handline landings of each major species by the annual number of handline trips that caught any PPMUS.

Daily trips were assumed. Unsuccessful (no-catch) trips were not included; such data generally have not been reported by fishermen and were not processed prior to 1989. Only major tuna species caught by handline are shown here. Bigeye catch per trip may have errors due to reporting of bigeye as "bluefin" or yellowfin tuna, but due to the relative volume of landings, the resulting errors in the yellowfin statistics are probably small.

Interpretation: From 1981-83, landings of albacore and bigeye tuna increased while yellowfin was depressed, and then in 1985-86 were low when yellowfin peaked. Yellowfin CPT declined through 1990, and then increased rapidly. In 1993, yellowfin CPT rose to a record peak. The recent rise in bigeye CPT may due to the contribution of handline fishermen fishing around weather buoys and offshore seamounts. Note: the bigeye tuna CPT in recent years may be over-estimated slightly due to multi-day trips taken by fishermen working offshore seamounts or weather buoys, but the trend of increasing catch per trip appears to be real.

Appendix 4

Northern Mariana Islands

Introduction

The Northern Mariana Islands pelagic fishery occurs primarily around the islands of Saipan, Tinian, Rota and Aguigan. The fishery is characterized using data in the Commercial Purchase Data Base. The collection system for the data is dependent upon first-level purchasers of local fresh fish to accurately record all fish purchases by species categories on specially designed invoices. Staff from the Department of Natural Resources, Division of Fish and Wildlife (DFW) routinely distribute and collect invoice books from 46 participating local fish purchasers on Saipan. Purchasers include practically all fish markets, stores, restaurants, hotels and roadside vendors ("fish-mobiles"). Tinian and Rota were included in the Commercial Purchase data collection system for the first time during 1993, with 13 vendors participating on Rota and ten on Tinian. Data collection commenced on Rota during March 1993 and on Tinian during August 1993. Existing software programs are in need of revision for data entry and analysis.

Although the Saipan data collection system has been in operation since the mid-1970s, only data collected since 1983 are considered accurate enough to be used. Data quality, with respect to accuracy of landings and species identification on the invoice, is in need of investigation and conclusions reached in this report should be considered provisional. Fortunately, the most complete data were obtained from the larger operations, so general landings trends, while under-estimated, are believed to be accurate.

This database lacks information concerning fishing method, location and effort, but the Offshore Port Sampling Survey could provide the additional data required for further analysis. Although NMFS Honolulu Lab personnel finalized the computer programs necessary to estimate total landings and effort by method during 1993, the databases were not yet ready for analyses, and could not be included in this report.

To fish commercially within the NMI EEZ, commercial vessels over five net tons must have a Commercial Fishing License, issued annually and jointly by the Department of Commerce & Labor and the Department of Natural Resources. Depending on the information supplied in the application package, the DFW may impose certain fishing restrictions in the form of license conditions.

Summary

Trolling is the primary fishing method utilized in the pelagic fishery. The pelagic fishing fleet, other than charter boats, consists primarily of vessels less than 24 feet in length which usually have a limited 20-mile travel radius from Saipan. In 1993, approximately 72% of all registered boats participated in some form of fishing activity. With respect to full-time commercial fishing, 88 vessels were identified, whereas 73 vessels were classified as part-time commercial fishing. Subsistence fishing and/or recreational usage included 227 vessels. Fishing trips are generally restricted to daylight hours.

In 1993, 39 vessels were registered with the Boating Safety Office as charter vessels, although only eight vessels conduct full-time charter fishing operations. The remaining 31 charter vessels are associated with the tourist industry. Each charter vessel generally retains its catch and sells at least half to local markets. The magnitude of charterboat sales are unknown, but at this time it is believed that the local market can absorb the catch without impacting the commercial fishermen. A logbook system was established in early 1993 for six charter fishing vessels (pelagic) to obtain daily catch and effort data. Unfortunately, the data collection system deteriorated over time due to lack of manpower and several uncooperative boat captains.

The primary target species for the pelagic fleet are skipjack tuna and mahimahi. During their seasonal runs, these fish usually inundate nearshore waters and provide easy targets for the local fishermen. In addition to the economic advantage of being nearshore and relative ease of capture, these two species are widely accepted by all ethnic groups, and market demand usually remains high due to the recent population growth on Saipan.

The use of larger vessels (>50 feet) for pelagic fishing remains limited. Two commercial fishing licenses were issued in 1993 and two in 1992 (no licenses were issued during 1991). None of these vessels fished more than 12 months and one vessel appears not to have fished at all. Fisheries development by foreign vessels may have been impeded by US regulations. For example, several inquires by potential investors from the Peoples Republic of China and Hong Kong are believed to have ended when Coast Guard vessel documentation requirements were discussed (documentation procedures require commercial fishing vessels over five net tons to be majority-owned by US citizens).

During 1993, only one of the two licensed fishing vessels, the F/V CHARITO, directed it's efforts at the pelagic longline fishery. The 21 net ton vessel only made one trip before experiencing Federal permitting problems as well as violating the NMI license permit conditions. Currently, the vessel is satisfying appropriate Federal commercial fishing regulations.

Recommendations

1. An examination of the entry/exit patterns of fishermen over the past four years should be completed.

2. A careful review and comparisons of length frequencies and regional landings should be done

Tables

page

1. NMI 1993 commercial pelagic landings, revenues and price 4-4

Figures

page

1. NMI annual commercial landings -- all pelagics, tuna and PPMUS 4-6
2. NMI annual commercial landings -- mahimahi, wahoo, and marlin 4-8
3. NMI annual commercial landings -- skipjack and yellowfin tuna 4-10
4. Number of NMI fishermen (boats) making commercial pelagic landings 4-12
5. NMI number of pelagic trips 4-14
6. NMI average inflation-adjusted price of PPMUS 4-16
7. NMI annual commercial adjusted revenues 4-18
8. NMI annual commercial adjusted revenues for PPMUS trips only 4-20
9. NMI trolling catch rate of mahimahi, wahoo and marlin 4-22
10. NMI trolling catch rates of skipjack and yellowfin tuna 4-24

Table 1. NMI 1993 commercial pelagic landings, revenues and price

Species	Landings (lb)	Revenue ($)	Ave. Price ($/lb)
Misc. tunas	833	1,387	1.67
Skipjack tuna	77,832	133,203	1.71
Dogtooth tuna	1,979	4,285	2.17
Yellowfin tuna	11,919	26,510	2.22
Subtotal Tunas	**90,584**	**161,100**	**1.78**
Troll fish	16,232	26,825	1.65
Mahimahi	30,036	47,784	1.59
Marlin	2,950	3,036	1.03
Spearfish	309	378	1.22
Sailfish	96	241	2.50
Wahoo	2,257	4,277	1.89
Subtotal Other PPMUS	**37,628**	**60,001**	**1.59**
Barracuda	27	54	2.00
Rainbow runner	644	1,156	1.80
Subtotal Misc.	**671**	**1,210**	**1.90**
All Pelagics	**145,115**	**249,136**	**1.72**

Source and Calculation: Annual summaries for each species from the Commercial Purchase Data Base invoices.

Interpretation: Although landings remained depressed for skipjack tuna during 1993, this species continued to dominate weight and revenue statistics when compared with other landed species. Mahimahi and yellowfin tuna ranked second and third in total landings during 1993 and comprised approximately 21% and 8%, respectively. Schools of mahimahi, like skipjack tuna, are easily caught in nearshore waters, especially in the vicinity of FADs. Mahimahi are highly seasonal, usually peaking during March and April, but during 1993 the mahimahi season was unexplainably protracted.

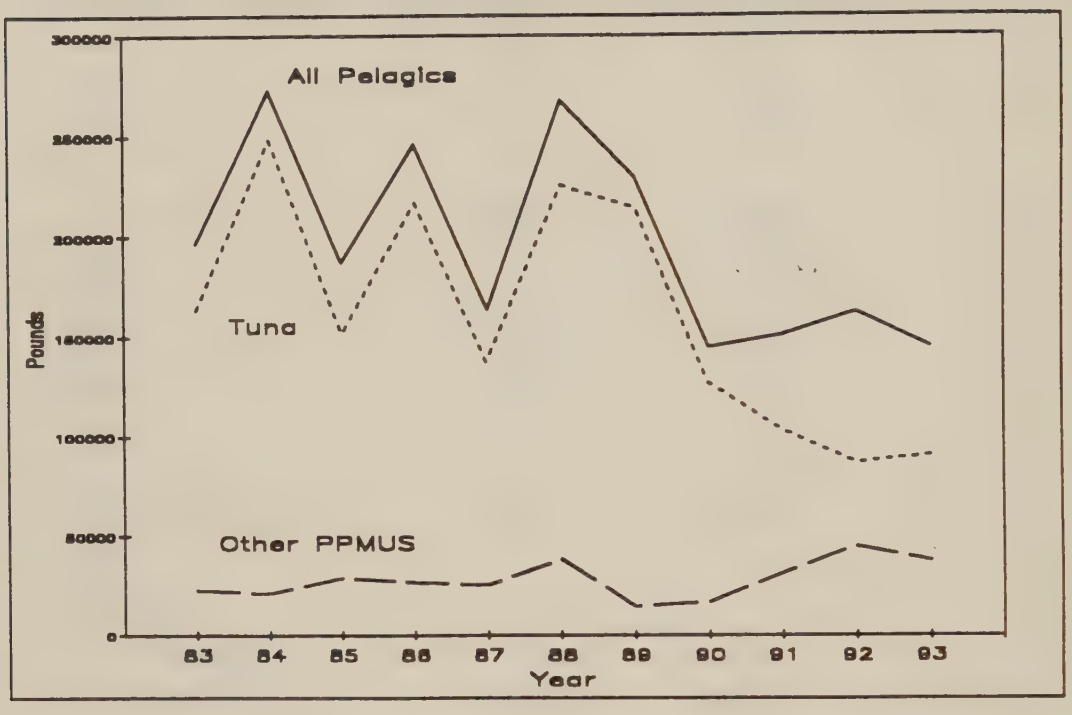
Average prices of identified pelagic species ranged from a high of $2.50/lb for sailfish to a low of $1.03/lb for marlin. Sailfish, which brought the highest average price, and barracuda, which brought a premium of $2.00/lb, are based on very few records and are not realistic prices on Saipan.

Combined yellowfin tuna and mahimahi revenues comprised 30% of the total pelagic revenues. Historically, as well as during 1993, yellowfin tuna commanded the best price as it is the species of choice with the restaurant industry. Skipjack tuna, the species with the greatest landings, received only $1.71/lb on average and generated 53% of the total pelagic revenues for 1993.

Blue marlin, which brought the lowest average price per pound, is taken primarily by charterboa fishermen, as well as other fishermen during scheduled fishing tournaments. Although not regarded as an excellent eating fish, marlin sashimi is sold in local restaurants. The low ex-vess

price could be partly related to the manner which the fish is kept prior to sale and the bulky size. These large fish (relative to the other pelagic species caught) are generally not iced when caught and, therefore, are usually of lower quality at the time of sale. Fishermen usually wish to sell the whole fish to avoid cleaning and repackaging the fish into smaller units for sale to restaurants.

Figure 1. NMI annual commercial landings -- all pelagics, tuna and PPMUS



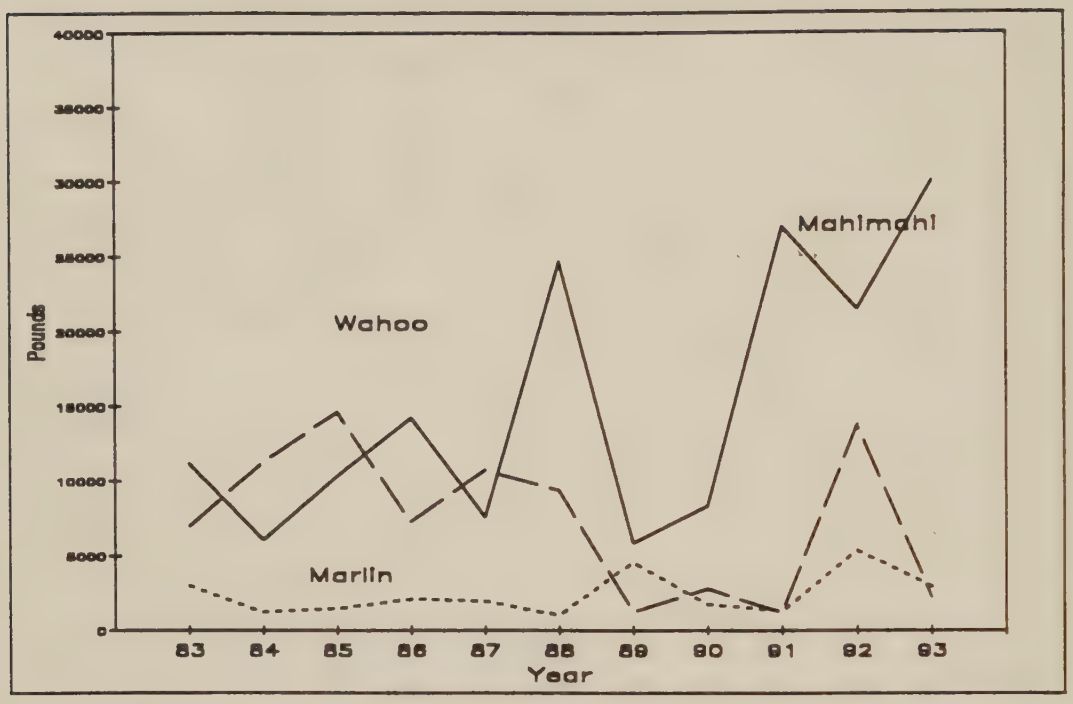
	Total Landings (lb)		
Year	All Pelagics	Tunas	Other PPMUS
1983	196,788	163,754	23,081
1984	272,909	248,339	21,223
1985	187,378	151,882	29,105
1986	245,967	217,023	26,800
1987	164,055	137,566	25,467
1988	267,619	225,498	38,368
1989	229,427	214,249	14,650
1990	144,862	127,172	16,893
1991	150,915	103,078	31,300
1992	162,691	86,931	45,061
1993	145,115	90,584	37,628

Source and Calculation: All pelagics, tuna and other PPMUS landings were summed from the Commercial Purchase Data Base.

Interpretation: 1993 landings remained somewhat constant from 1992 with tuna increasing and all pelagics and other PPMUS decreasing, however, no landings category exceeded a 17% chang from 1992.

While tuna landings increased slightly, they remained well below the long-term average. Other PPMUS landings declined slightly, but remained above the long-term average. Total pelagics landings declined somewhat and remained at the lower extreme of the range.

Figure 2. NMI annual commercial landings -- mahimahi, wahoo, and marlin



Total Commercial Landings (lb)

Year	Mahimahi	Wahoo	Blue Marlin
1983	11,151	7,008	3,030
1984	6,091	11,270	1,235
1985	10,364	14,601	1,488
1986	14,237	7,250	2,123
1987	7,602	10,723	1,968
1988	24,639	9,358	1,047
1989	5,856	1,257	4,563
1990	8,306	2,770	1,748
1991	27,005	1,217	1,320
1992	21,462	13,738	5,345
1993	30,036	2,257	2,950

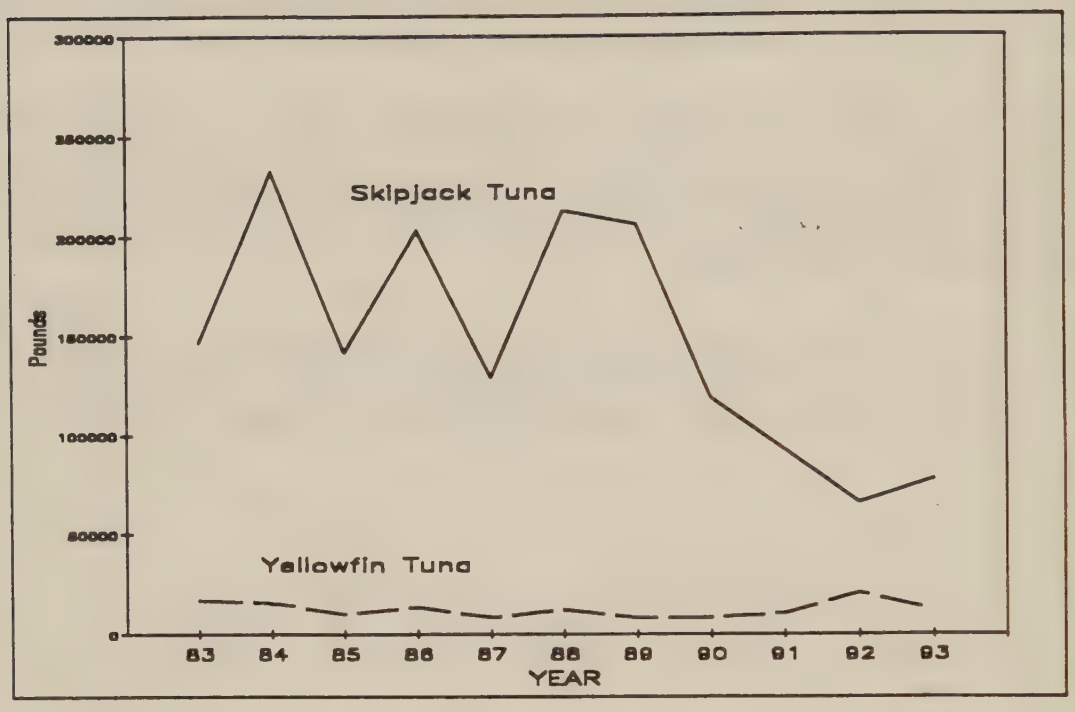
Source and Calculation: The annual commercial landings of the three major PPMUS species (mahimahi, wahoo and blue marlin) were summed directly from the Commercial Purchase Data Base.

Interpretation: Mahimahi landings reached a record high in 1993, exceeding the previous 1991 record by 11%. Although the FADs had not been completely deployed until August 1993, the local fishermen believe FADs were responsible for the excellent mahimahi season in 1993. The unexplained protracted mahimahi season is also believed to have played a role in the record landings. Although no explanation can be offered for the erratic mahimahi landings pattern, the past three years have been substantially greater than the 11-year mean of 15,159 lb.

From 1983 to 1988, wahoo landings were somewhat consistent and did not fall below 7,000 lb, but the 1989 landings notably declined by 86% and remained at depressed levels until the dramatic increase in landings during 1992. Following the near-record 1992 landings, the 1993 wahoo landings again decreased by 84%, falling below the 11-year mean of 7,404 lb. The landings pattern is unexplained.

Blue marlin landings have historically remained at levels less than 3,000 lb with the exception of the 1992 record of 5,345 lbs, a three-fold increase from 1991. However, the 1993 landings decreased by 45% and remained slightly above the 11-year mean of 2,438 lb.

Figure 3. NMI annual commercial landings -- skipjack and yellowfin tuna



	Total Commercial Landings (lb)	
Year	Skipjack tuna	Yellowfin tuna
1983	146,729	17,025
1984	232,675	15,664
1985	141,910	9,973
1986	203,490	13,533
1987	129,203	8,363
1988	213,198	12,300
1989	206,162	8,087
1990	118,798	8,374
1991	92,642	10,433
1992	65,982	20,672
1993	77,832	11,919

Source and Calculation: Landings were summed directly from the Commercial Purchase Data Base.

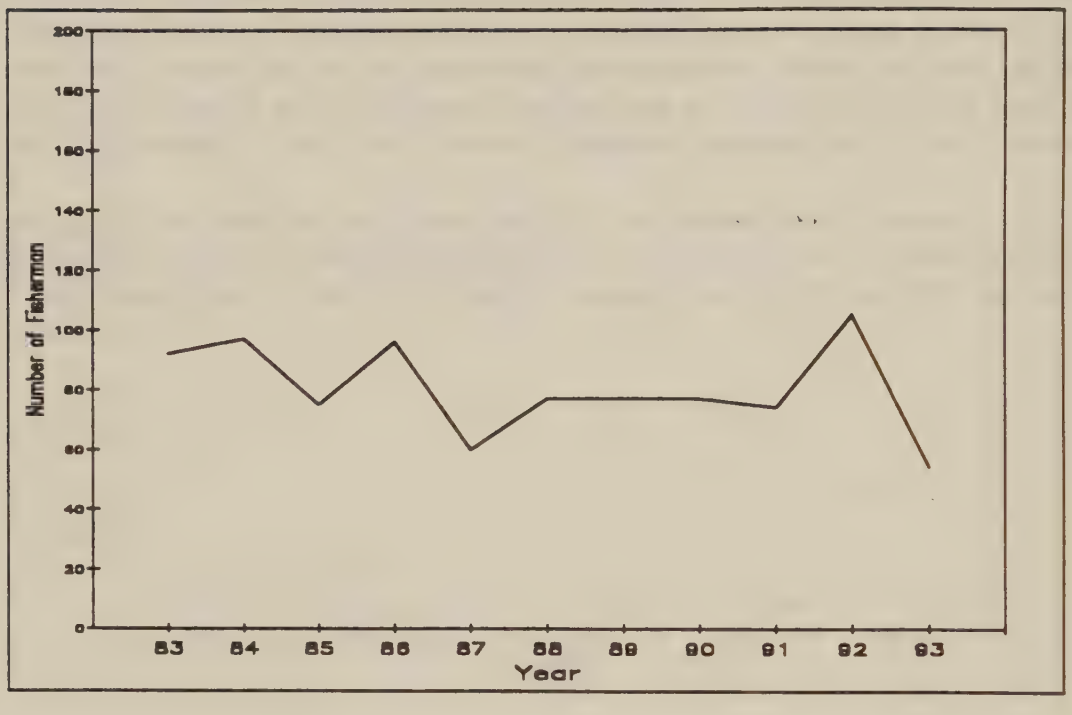
Interpretation: Historically, skipjack landings exhibited an alternating two-year cycle from 198 to, 1988 and comprised over 73% by weight of the total pelagic landings each year from 1983 t

1989 (data taken from Figs. 1 and 3). Skipjack tuna landings declined after that, setting record lows in 1990, 1991 and 1992. In 1993, skipjack landings increased slightly, but were still half of the 11-year mean of 148,056 lb.

Schools of skipjack tuna have historically been ubiquitous in nearshore waters, thus providing an opportunity to catch numerous fish with a minimum of travel time and fuel costs. Unlike Guam, skipjack tuna are readily consumed and even prized by the indigenous population. Although it is believed that the highliners are moving away from the fishing industry and, thus, causing the downturn in skipjack landings, biological reasons should not be eliminated at this time.

In Saipan waters, yellowfin tuna are not often taken, and the average fish size tends to be smaller compared with yellowfin tuna from other geographic areas. The 1993 landings declined by 42% from the 1992 record high and remained slightly below the 11-year mean of 12,395 lb.

Figure 4. Number of NMI fishermen (boats) making commercial pelagic landings



Year	No. fishermen landing any pelagic species
1983	92
1984	97
1985	75
1986	96
1987	60
1988	77
1989	77
1990	77
1991	74
1992	105
1993	54

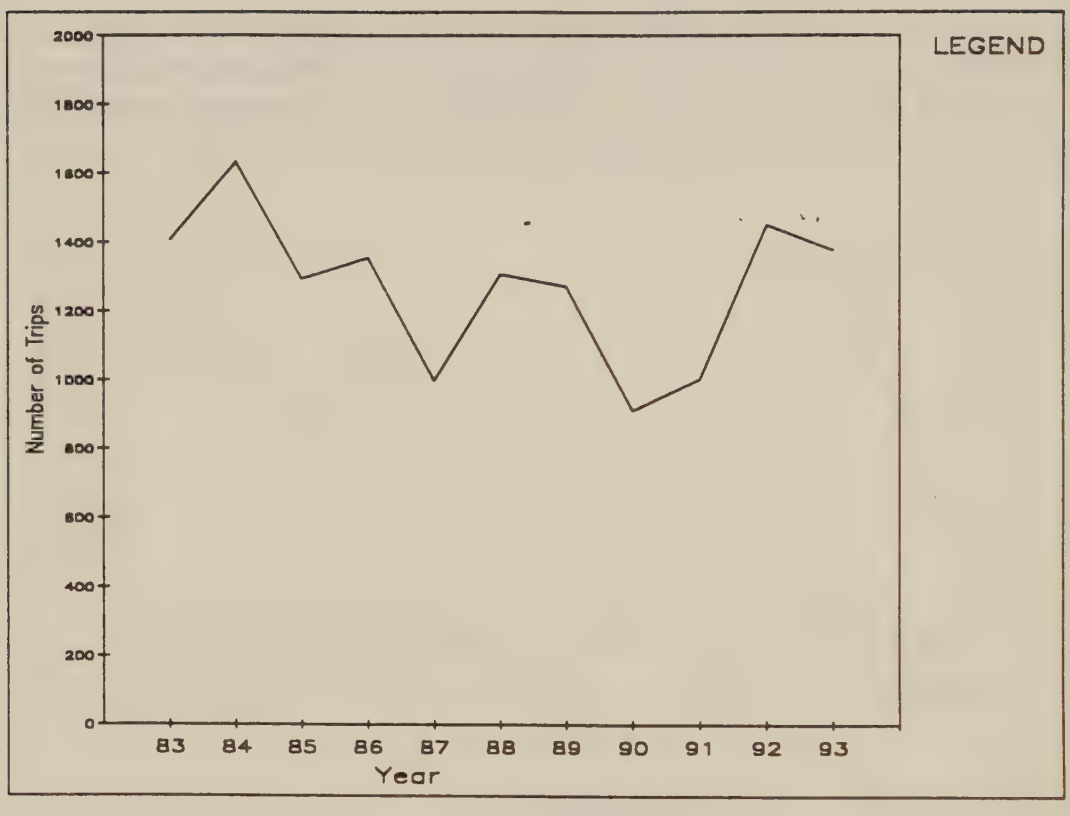
Source and Calculation: Each invoice from the Commercial Purchase Data Base records the fisherman's name from whom the fish were purchased. The number of fishermen who sold any pelagic species were calculated directly from the data invoices.

Interpretation: The number of fishermen (boats) making commercial pelagic landings was relatively constant from 1988-91 compared to earlier years, but a record high number was

recorded for 1992 (+42% from 1991). Some of the increase in 1991 was attributable to the influx of new fishing boats as a result of money obtained by leasing property. In addition, it was discovered that some fishermen were using several different boats, thus artificially inflating the total number of boats making pelagic landings.

During 1993, the lowest number of fishermen (boats) making pelagic landings was recorded, a 49% decrease from 1992. Many of the "new" fishermen which appeared during 1992 with their new boats are believed to have the fishery during 1993. A entry/exit pattern of fishermen and boats within the fishery should be completed for the past three years.

Figure 5. NMI number of pelagic trips

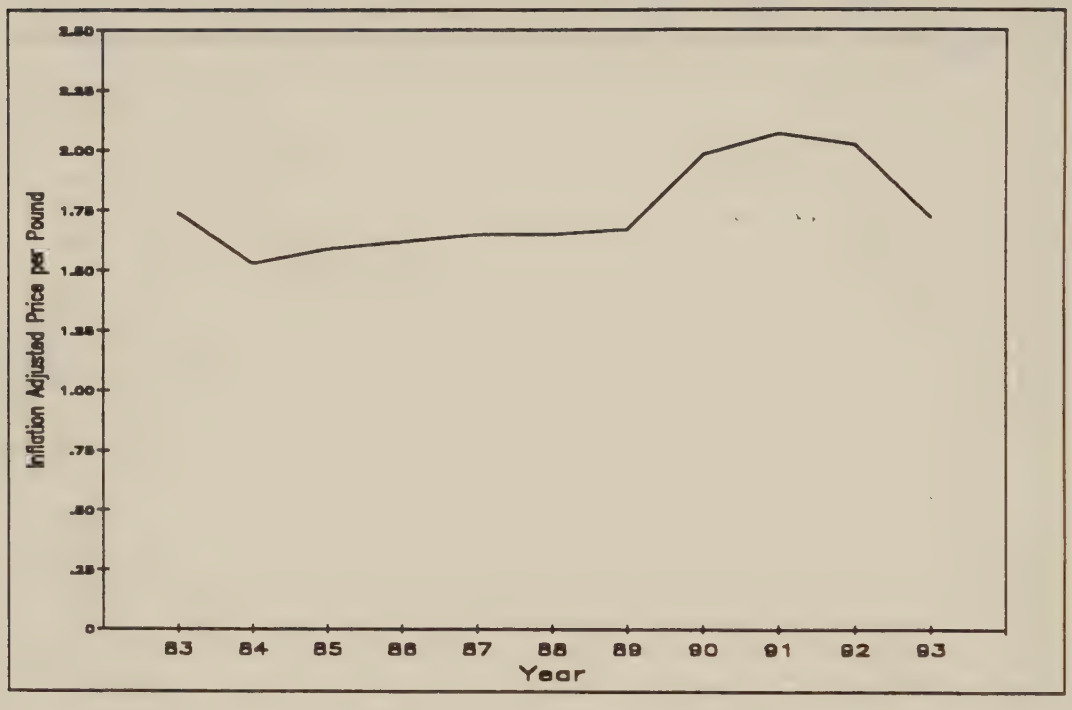


Year	Number trips
1983	1,408
1984	1,634
1985	1,293
1986	1,356
1987	999
1988	1,306
1989	1,272
1990	910
1991	1,002
1992	1,451
1993	1,378

Source and Calculation: The total trips for all pelagic species were summed from the Commercial Purchase Data Base. Trips were calculated based on the assumptions that no fisherman makes more than one trip per day, and that all sales from a single trip are made on a single day.

Interpretation: With a decrease of only 5% from 1992, the number of pelagic trips has remained fairly constant throughout the 11-year sample period. It would be expected that the number of pelagic trips follow the same decline as the number of fishermen landing any pelagic species (Fig. 4), but that was not the situation. It is suspected that multiple invoices are being submitted for single fishing trips which would cause the number of pelagic trips to be inflated. The magnitude of this data problem needs to be assessed and, if necessary, corrected.

6. NMI average inflation-adjusted price of PPMUS



	Average Price ($/lb)			
	Tunas		Other PPMUS	
Year	Unadjusted	Adjusted	Unadjusted	Adjusted
1983	0.99	1.71	1.12	1.93
1984	0.95	1.51	1.15	1.84
1985	1.02	1.56	1.14	1.74
1986	1.07	1.59	1.22	1.81
1987	1.14	1.62	1.27	1.80
1988	1.20	1.62	1.35	1.83
1989	1.29	1.65	1.48	1.89
1990	1.56	1.91	2.07	2.53
1991	1.80	2.04	1.92	2.17
1992	1.91	1.99	2.01	2.09
1993	1.78	1.78	1.59	1.59

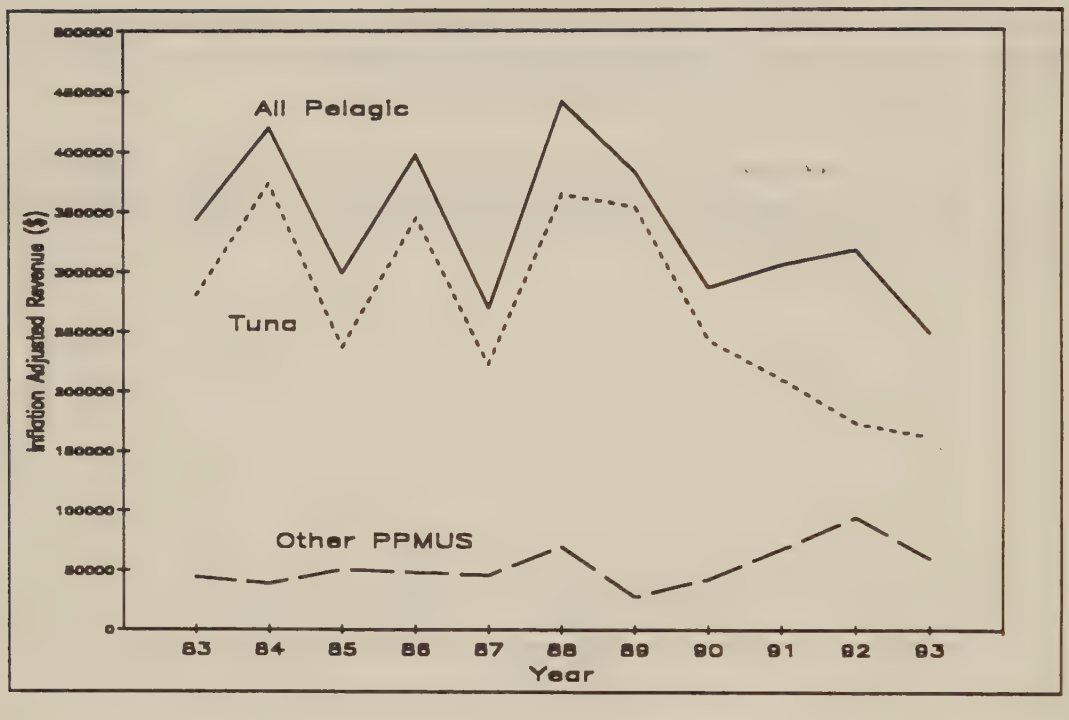
Source and Calculation: The unadjusted average price is calculated by dividing the total revenues generated by the total weight sold. The inflation adjustment is made using the 1993 NMI Consumer Price Index (CPI) as the basis by which calculations of previous years' prices ar

made. The CPIs for 1983-87 were not available from the appropriate NMI agency and were, therefore, estimated by using Guam's annual inflation rate to proportionately adjust the NMI CPI.

Interpretation: The inflation-adjusted average price of tuna displayed a gradual increase from 1984 until 1990, when an obvious rise was observed. The 1990-93 rise in price correlates well with the notable decrease in skipjack tuna landings (Fig. 3) during the same period of time. Increased demand most likely maintained the higher prices during this period of depressed landings. Although the 1993 inflation-adjusted average price of tuna decreased $0.21/lb, it remained slightly above the 11-year mean of $1.73.

The inflation-adjusted average price of other PPMUS follow the same general trends as tuna, however, the unexplained 1990 rise is much more evident. The 1993 average price of $1.59 is below the 11-year mean of $1.93.

Figure 7. NMI annual commercial adjusted revenues



	Revenues ($)					
	All Pelagics		Tunas		Other PPMUS	
Year	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
1983	198,710	343,768	162,240	280,675	25,770	44,582
1984	264,203	420,083	235,262	374,067	24,503	38,960
1985	195,372	298,919	155,171	237,412	33,162	50,738
1986	267,013	397,849	231,745	345,300	32,631	48,620
1987	190,150	270,013	156,634	222,420	32,333	45,913
1988	327,260	441,801	270,679	365,417	51,950	70,133
1989	299,142	382,902	276,671	354,139	21,635	27,693
1990	235,520	287,334	198,775	242,506	34,968	42,661
1991	271,030	306,264	185,662	209,798	60,031	67,835
1992	305,927	318,164	166,235	172,884	90,627	94,252
1993	249,136	249,136	161,100	161,100	60,001	60,001

Source and Calculation: Annual revenue in dollars was summed separately for all pelagic fish, tunas and other PPMUS. Inflation-adjusted revenues were calculated using the Consumer Price Index, with 1993 as a base by which previous years' nominal prices are adjusted. The CPIs for

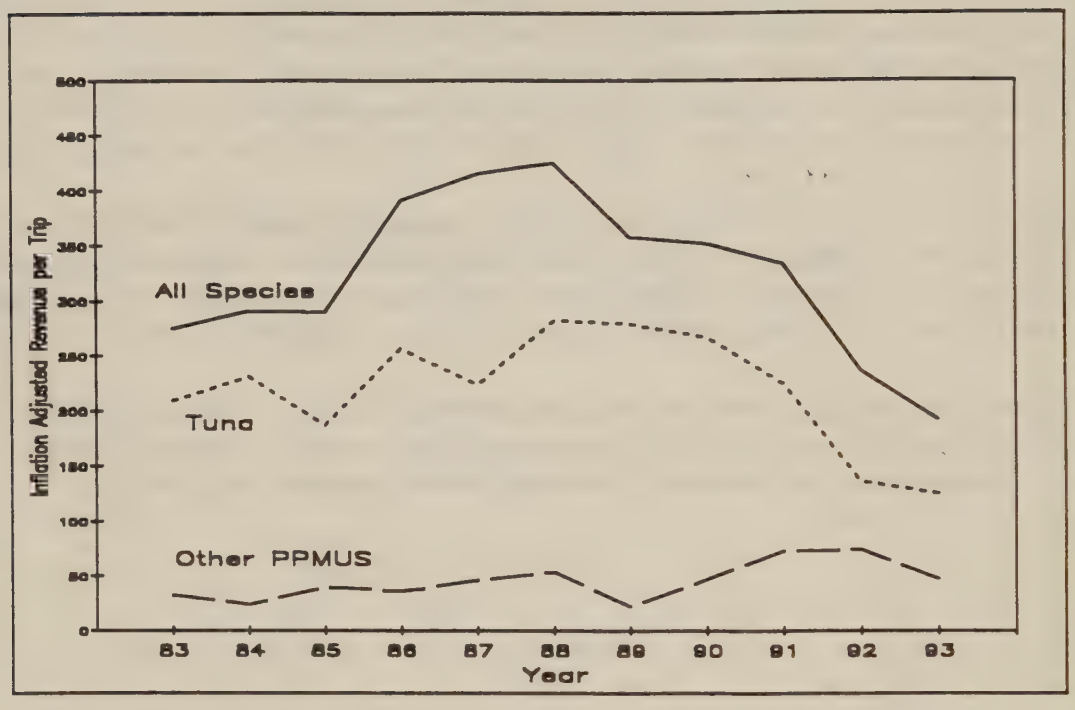
1983-87 were not available from the appropriate NMI agency and were, therefore, estimated by using Guam's annual inflation rate to proportionately adjust the NMI CPI.

Interpretation: The erratic fluctuations of the inflation-adjusted revenues for tuna and for all pelagic pelagics prior to 1990, is most likely due to the annual variations in skipjack tuna landings (see Fig. 3) which completely dominate the tuna category and, therefore, the all pelagics category. During 1991 and 1992, inflation-adjusted revenues from these two categories began diverging with all pelagic revenues increasing at approximately the same rate as tuna revenues were decreasing. The increase in all pelagic revenues during this period is most likely due to the positive influence of the other PPMUS revenue, which offset the tuna revenue decline.

There was an obvious decline in tuna inflation-adjusted revenues which commenced in 1990. Both the 1993 all pelagics and tuna inflation-adjusted revenue categories are below their respective 11-year means. Although other PPMUS inflation-adjusted revenues decreased by 36% in 1993 (from 1992), they remained above the 11-year mean of $53,763.

Skipjack tuna landings have been declining since 1990 (Fig. 3). Unfortunately, it appears that market demand has not increased the ex-vessel price enough to keep up with the current inflation rate. The economic importance of non-tuna species appear to be on the rise.

Figure 8. NMI annual commercial adjusted revenues for PPMUS trips only



	Revenues per PPMUS Trip ($)					
	All Pelagic Species		Tunas		Other PPMUS	
Year	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
1983	159	275	121	209	19	33
1984	183	291	145	231	15	24
1985	189	290	122	187	26	40
1986	262	391	172	257	24	36
1987	292	415	157	224	32	46
1988	315	425	209	282	40	54
1989	279	358	218	279	17	22
1990	289	352	219	267	39	47
1991	295	334	199	225	64	73
1992	228	237	130	136	71	74
1993	192	192	125	25	47	47

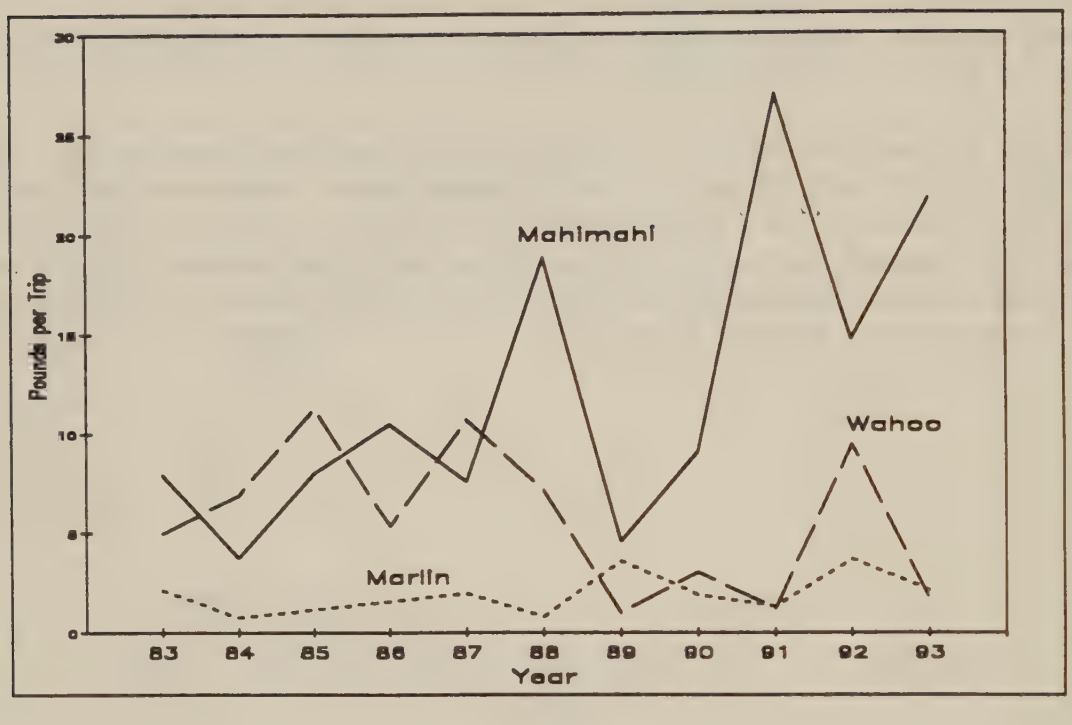
Source and Calculation: Values were obtained by selecting, from the Commercial Purchase Data Base, all trips which landed at least one PPMUS, and then calculating a) the average revenue of all species, b) the average revenue of other PPMUS only, and c) the average revenue of tuna only. Inflation-adjusted revenues were derived from the NMI Consumer Price Index

(CPI) which used 1993 as a base. The CPI for 1983-87 were not available from the appropriate NMI agency and were, therefore, estimated by using Guam's annual inflation rate to proportionately adjust the NMI CPI.

Interpretation: The inflation-adjusted revenues for all species and tuna have been declining slowly since the 1988 record highs and reached record lows in 1993. The current year inflation-adjusted revenues of both categories are well below their respective 11-year means.

Inflation-adjusted revenues for other PPMUS, which have been increasing since 1990, decreased 36% in 1993. With the 5-year decline of inflation-adjusted revenues for tuna and all species and the steady increase of other PPMUS during 1990-1992, it was believed that other PPMUS was gaining importance over the tuna species. If this assumption remained valid for the 1993 season, inflation-adjusted revenues for other PPMUS should have increased or remained constant. The reason for the 1993 decrease is unknown.

Figure 9. NMI trolling catch rate of mahimahi, wahoo and marlin



	Trolling Catch Rate (lb/trip)		
Year	Mahimahi	Wahoo	Marlin
1983	7.92	4.98	2.15
1984	3.73	6.90	0.76
1985	8.02	11.29	1.15
1986	10.50	5.35	1.57
1987	7.61	10.73	1.97
1988	18.87	7.17	0.80
1989	4.60	0.99	3.59
1990	9.13	3.04	1.92
1991	26.95	1.21	1.32
1992	14.79	9.47	3.68
1993	21.80	1.64	2.14

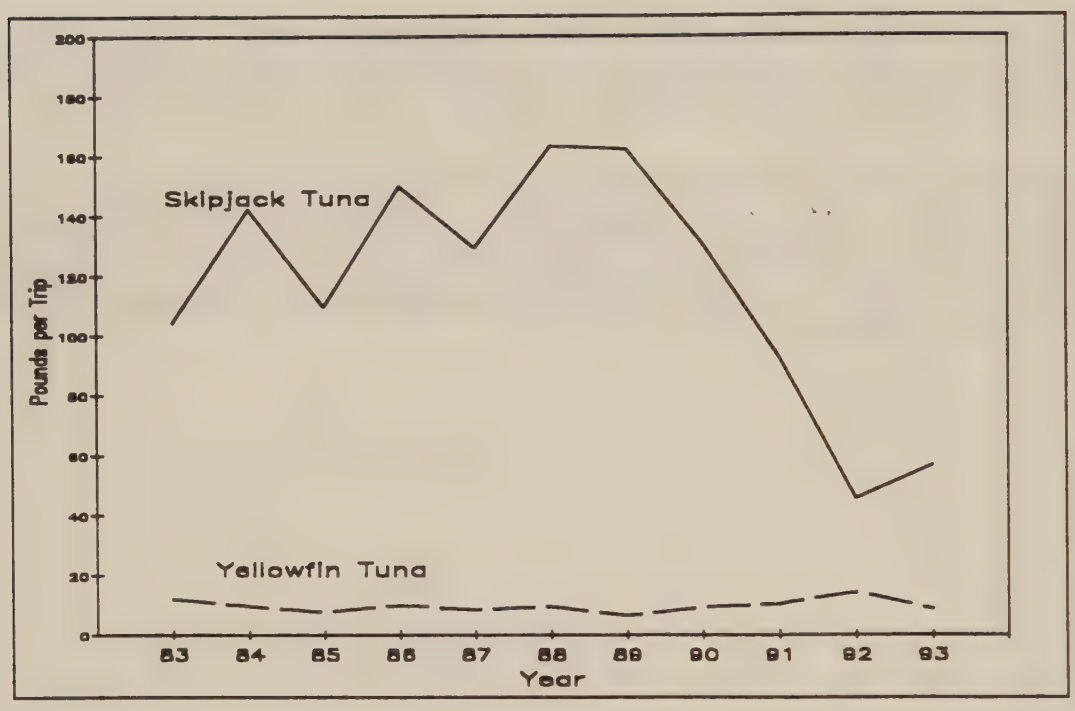
Source and Calculation: Annual catch rates for selected species were obtained by calculating the average weight per trip for each year. Trips were assumed to be one day in length and each invoice represented one trip.

Interpretation: The 1993 mahimahi catch rate of 21.80 lb per trip became the second highest recorded and was nearly twice the 11-year mean of 12.17 lb per trip. The high catch rates could have resulted from the presence of the FADs, which made the fish more accessible, and the protracted fishing season.

Prior to the 1989 record low, wahoo catch rates rivaled mahimahi. Since 1989 and with the one exception in 1992, wahoo catch rates never regained those historical levels. The 83% decrease in the 1993 catch rate (from 1992) is less than the 11-year mean of 5.71 lb per trip.

Marlin catch rates, relative to mahimahi and wahoo, are historically low with a record high catch rate of 3.68 lb per trip occurring during 1992. Although the 1993 catch rate decreased, it remained greater than the 11-year mean of 1.91 lb per trip. The higher catch rates exhibited during 1992 and 1993 could be due to a developing charter boat fishery which may tend to target this species more often.

Figure 10. NMI trolling catch rates of skipjack and yellowfin tuna



Year	Trolling Catch Rate (lb/trip)	
	Skipjack	Yellowfin
1983	104.21	12.09
1984	142.40	9.59
1985	109.75	7.71
1986	150.07	9.98
1987	129.33	8.37
1988	163.25	9.42
1989	162.08	6.36
1990	130.55	9.20
1991	92.46	10.41
1992	45.47	14.25
1993	56.48	8.65

Source and Calculation: Data were summarized from the Commercial Purchase Data Base, which provides average pounds caught per trip. Annual catch rates for selected species were obtained by calculating the average weight per trip for each year. Trips were assumed to be one day in length and each invoice represented one trip.

Interpretation: Catch rates for skipjack tuna decreased dramatically commencing in 1990. Although the 1993 catch rate increased by 24%, it remained far below the 11-year mean of 116.91 lb per trip. Skipjack tuna are the preferred species in the troll fishery of the NMI because of their relative ease of capture and local popularity. Previous discussions have suggested that non-tuna PPMUS may be increasing in value and a slight shift in target troll fish may be occurring, especially since the skipjack jack tuna appear to not be as abundant as historically recorded.

In contrast, catch rates of yellowfin tuna per trip have been increasing since 1990, except for the 39% decrease experienced in 1993. The 1993 value was lower than the 11-year mean of 9.64 lb per trip. Yellowfin tuna were not encountered often and were usually taken incidentally while targeting other species.

Appendix 5

1993 Pelagics Research and Publications

There are two parts to this appendix. A summary of pelagics related research and a list of publications and reports by NMFS is in the first part. The second part is a progress report from the Pelagic Fisheries Research Program, sponsored by the Council, NMFS and University of Hawaii.

NMFS Pelagics Research[1]

Following is a summary of research involving pelagic resources conducted by the NMFS in 1993 in the western Pacific region, or on fisheries of interest to the western Pacific region (e.g., pelagic fisheries in California or the North Pacific). The material was extracted primarily from bi-monthly reports of activities published by the Southwest Fisheries Science Center (SWFSC).

Hawaii Longliners Tag and Release Billfish

From January 1991 through January 1993, Hawaii's commercial longline fishermen have tagged and released 119 swordfish (*Xiphius gladius*), 7 other billfish, and 13 bigeye tuna (*Thunnus obesus*). Longline vessels most active in tagging fish included the *Seeker II* operated by David Ghigliotty, *Edward G* operated by Tony Geisman, and *Gail Anne* operated by Bobby LaRue. Each of these vessels tagged and released over 30 fish. The Hawaii longline vessels involved in tagging generally target swordfish and tag small (10-40 lb) fish with little market value. They may also tag a few tuna near the beginning of long trips, since tuna do not keep as well as swordfish. The *Gail Anne* recently (1993) tagged a small (10 lb) bluefin tuna (*T. thynnus*). Due to the northward expansion of the Hawaii fishery, bluefin tuna are caught more frequently by this fishery.

Tags are provided by the Cooperative Marine Gamefish Tagging Program (CMGTP) at the National Marine Fisheries Service's (NMFS) La Jolla Laboratory and distributed to Hawaii longline fishermen by Robert Dollar of the NMFS Honolulu Laboratory. Recovery of these tags is rewarded with tagging caps. The Honolulu Laboratory has also been tagging and releasing longline-caught fish on research cruises since 1989, using either CMGTP tags or special tags marked "$REWARD FOR FISH HEAD" to tag billfish that have been injected with oxytetracycline for growth studies. Recovery of these special tags is rewarded by cash payment of up to $100. By January 1993, a total of 102 fish have been tagged with the special cash-reward tags.

The number of fish tagged and released from longline gear in Hawaii (commercial and research cruises combined) through January 1993 totals 339 fish including 142 swordfish, 41 striped marlin (*Tetrapturus audax*), 27 blue marlin (*Makaira mazara*), 16 spearfish (*T. angustirostris*), 56 bigeye tuna and 16 yellowfin tuna (*T. albacares*). The most unusual fish tagged so far were 6 opah (moonfish, *Lampris guttatus*).

---

[1] Compiled from bi-monthly reports of activities of the Honolulu Laboratory, Southwest Fisheries Science Center for January-February, March-April, May-June, July-August, September-October, and November-December 1993.

Of these released fish, 2 bigeye tuna and a striped marlin were recovered. The recovered fish were released during research cruises in 1989 and 1990, and research suggests that these two species are most likely to survive being caught and released (Boggs 1992, Fish. Bull. 90:642-658). The low overall recovery rate (3 out of 339) may imply a high rate of tagging mortality, problems with the reporting of tag recaptures, or a high fish turnover rate in the Hawaii area. Several tags that escaped the attention of fishermen were recovered by Honolulu Lab staff at the United Fishing Agency fish auction in Honolulu. Some species such as swordfish are largely sold through market channels other than the Honolulu auction. This fact and reduced Honolulu Lab sampling staff activity at the auction (due to budget cuts) may lead to fewer tag recoveries.

Commercial longline fishermen have been helpful in recovering fish tagged by troll fishermen. Hawaii longline fishery recaptures accounted for 50 percent of the striped marlin tag recoveries reported to the SWFSC in 1991 (1992 Billfish Newsletter). Eight striped marlin and one blue marlin were recovered by the Hawaii longline fishery in 1990-92. Two of the recoveries were striped marlin tagged off southern California, and the rest were marlin tagged off Hawaii. Another long-distance recovery was a skipjack tuna (*Katsuwonus pelamis*) tagged and released over 2,000 miles away in the Solomon Sea and recovered southwest of Hawaii 16 months later by the Hawaii longline vessel *Big Al*.

Troll fishermen in Hawaii have also been increasingly active in the tagging program (SWFSC Report of Activities, November- December 1991, July-August 1992). The Hawaii troll fishery accounted for 33 percent of the striped marlin and 81 percent of the blue marlin reported tagged in the Pacific by the CMGTP in 1991. Together, Hawaii's trollers and longliners accounted for 10 of the 15 CMGTP Pacific billfish recaptures reported in 1991 (1992 Billfish Newsletter). Hawaii trollers have tagged over 1,000 blue marlin since 1980 including about 400 in 1991-92. (C. Boggs, 808-943-1222).

Prototype Development of a Data Analysis and Archival System for the North Pacific Transition Zone Driftnet Program

The efficient analysis of large data sets relies in part on effective data management and analytical tools. This is particularly true when analyses involve different types of data (that is, satellite data, fisheries data, etc.) collected at different scales. During a recent (1993) meeting of the Scientific Committee on Research Needs to discuss data base management at the Honolulu Laboratory, Gerard DiNardo, Fishery Biologist, presented the conceptual model and prototype system for an integrated Data Analysis and Archival System (DAAS) being developed for the North Pacific Transition Zone (NPTZ) Driftnet Program in collaboration with Craig Motell of CoastWatch. The system is being developed cooperatively with Al Coan, mathematical statistician, La Jolla Laboratory.

DAAS is modular in design and intended for use in storing, interpreting, and diagnosing physical and biological data collected in the NPTZ. System modules include data base, satellite image processing, mapping, data manipulation and analysis, graphics, and report writing. The integration of analytical tools with data base management provides users with an interactive system for efficient data management, browsing, and analysis. DAAS is UNIX based and networked to a Sun workstation which acts as a file server. The benefits of using a UNIX-based workstation system rather then a DOS-based PC system include (1) reduced computer run time, (2) increased storage capacity, (3) easy system updating (only have to update the system once), and (4) networking (several users can access the system simultaneously). (G. DiNardo, 808-943-1259)

Swordfish longline research cruise, TC-9303 Leg I

Townsend Cromwell cruise 93-03 Leg I was conducted from March 12 to April 8, 1993 to investigate swordfish, *Xiphias gladius*, biology and distribution relative to oceanographic features. The area of

operation extended from the boundary of the exclusive economic zone north of Oahu, Hawaii to 30°N latitude, with effort concentrated in the region of the Subtropical Front. A very steep sea surface temperature gradient, as great as 1.7°C, was observed at the front. Transects were conducted across and along the front to monitor the surface temperature using the thermosalinograph. Attempts were made to set the longline parallel to the front on both the cold and warm sides, as well as perpendicular to the front. A CTD cast was made at the conclusion of the longline sets.

Biological swordfish samples were collected for several ongoing research projects at the Honolulu Laboratory. Otoliths, anal and dorsal fin spines, and caudal vertebrae were collected for the age and growth study. Length measurements, weights, and the hyplural were collected from 43 swordfish for analysis of morphometric relationships. Ovarian tissues and weights were collected for the study of maturation and reproduction. Nine swordfish and 5 striped marlin, *Tetrapterus audax*, were injected with oxytetracycline, tagged and released to support the age and growth study and to provide information on stock structure. Fins from 13 blue sharks, *Prionace glauca*, and 3 shortfin mako, *Isurus oxyrinchus*, were measured and weighed fresh, then dried and reweighed to obtain fin weight to body weight relationship for utilization estimates. Collaborating scientists on the cruise collected tissue samples from the heart, liver, and white muscle for genetic studies, precaudal vertebrae for ageing, and stomach samples from swordfish for ecological studies by researchers at the *Centro de Investigación Cientifica y de Educación Superior de Ensenada*, Mexico. Fresh heater organs from 6 swordfish were collected for Dr. Barbara Block, University of Chicago (now at Stanford University), and 44 swordfish bills for Dr. Francis Carey, Woods Hole Oceanographic Institute, and 42 swordfish and 3 shortfin mako heart tissue samples for Dr. Edward Graves, Virginia Institute of Marine Studies. A couple of eye lenses were also collected for Dr. Joe Horowitz, Julius Stein Eye Institute, University of California at Los Angeles.

Study Completed on Pelagic Driftnet Fishery for Sharks and Swordfish

Al Coan, Mathematical Statistician; Dave Holts, Fishery Biologist; and Doyle Hanan of California Department of Fish and Game (CDF&G) have completed a study of California's drift gillnet (DGN) fishery for swordfish and sharks. This study includes the history of the fishery, catch and fishing effort summaries, California regulations, and summaries of biological data for the major species caught. Data used in the study were obtained from the California logbook system, landing receipts, and market samples collected over a period from 1981-82 through 1990-91.

During the 10-year period covered by the study, the fishery evolved rapidly from a small near shore enterprise targeting common thresher sharks, *Alopias vulpinus*, and shortfin mako shark, *Isurus oxyrinchus*, in the late 1970s to a major California fishery targeting sharks as well as swordfish, *Xiphias gladius*, and with valuable bycatch such as the opah, *Lampris guttatus*. Because of several emerging fishery conflicts and concerns for the fish resources, the state legislature enacted a series of laws regulating the new fishery. Major changes in nearly every aspect of the fishery occurred including boat and gear, fishing technique, fishing area and season, and targeted species.

The size of vessels in the DGN fleet varied between 20 and 90 feet in length. The nets used were usually 1,463 to 1,829 m (4,800 to 6,000 ft) long and were used to fish at a depth of 5.5 m to 7.3 m (18 to 24 ft). Nets were constructed of 3-strand #24 to #30 twisted nylon, tied to form meshes averaging 33.02 to 48.26 cm (13 to 29 in) stretched mesh. Fishing operations were conducted only at night.

In the first 5 years of the study period, total annual effort nearly doubled to a peak of 11,000 sets in the 1986-87 fishing season and subsequently declined to a low of 4,00 sets in the 1990-91 season. This decline coincides with increasing regulations governing this fishery, including regulations to limit entry and a spring closure on fishing for sharks.

The distribution of fishing effort shifted geographically from the near shore southern California Bight in the early 1980s to a more even distribution northward and offshore in the 1990s. The fishery now operates in an area between San Diego and Cape Mendocino. In 1986-87 and 1987-88, it extended into the waters off Washington and Oregon.

The number of vessel unloadings increased to a high of 3,500 in the 1983-84 season and decreased steadily to a low of 1,500 in the 1990-91 season. The number of DGN vessels in the fishery peaked in 1985-86 at 350 and decreased to less than 200 in the 1990-91 season. Landings per vessel decreased markedly from a high of 13 in the 1982-83 season to a low of 7 in the 1988-89 season.

Catches varied by fish species, season, and year. The 10-year mean annual landing was 2 million lbs for swordfish, 1 million lbs for common thresher, 262 thousand lbs for shortfin mako shark, and 80 thousand lbs for opah. Average landings over the last five years were quite close to the 10-year average although there is a declining trend in the total catch landed for most species. Prices per pound paid during the period ranged from $2.00 to $4.00 for swordfish, $1.00 to $2.00 for shark, and $0.25 to $0.50 for opah.

Average sizes of swordfish landed varied, but with no consistent trend. Average sizes of shortfin mako sharks decreased from 1982-83 through the 1985-86 fishing seasons but rebounded in the 1987-88 season. Average length of thresher sharks, however, decreased 30 percent over the period, coinciding with a decrease in landings as well.

A number of problems and conflicts occurred during the first 10 years of the fishery including bycatch of marine mammals and striped marlin, and conflicts with commercial harpoon fishers and recreational fishers. Most of these were resolved through the cooperative efforts of the principals involved.

Some concerns expressed when the fishery first started continue today. Specifically, high shark catches historically have not been sustained for shark fisheries and, in fact, tend to decline significantly or "crash" rather suddenly. The California DGN vessels catch primarily juvenile sharks within the Southern California Bight, especially shortfin mako sharks, and more recently, common thresher sharks. In response to declines in the common thresher shark catch and in average size of fish, the State virtually eliminated the directed common thresher shark fishery with area and season closures. If the number and size of shortfin mako sharks caught show similar declines, management controls may be appropriate for this species as well.

The incidental catch of marine mammals is apparently low and not compromising any stocks although the potential remains; therefore, NMFS is continuing to monitor the fishery. Bycatch of other fish does not appear to be adversely impacting other species except for the incidental catch of blue sharks which may have an adverse effect on local stocks. Nonetheless, the driftnet catch is controversial and generates three general types of controversy: (1) politically--to the environmentalists with the gray whale, minke whale, sea lion, dolphin, and blue shark bycatches and to the sportfishermen with the striped marlin bycatch; (2) economically--to the swordfish, salmon, albacore, and opah fishermen through lost revenue due to bycatch of these species; and (3) as a loss of novelty species--of special interest to this group are the megamouth shark and white shark.

By incorporating both landing receipt and logbook data along with market sampling data, authors of this study summarized important facets of the California drift gillnet fishery. The quality of all data collected for the DGN fishery, while relatively high in some areas, can be improved. The logbook system is very good and is accompanied by high coverage rates. There is some confusion in the way logbooks are completed, which could be eliminated if more complete instructions were provided to the fishermen. The current landing receipts might also be improved with better instructions to buyers and with inclusion of more specific gear codes. Coverage rates for market sampling are comparable to those of other California fisheries monitored by CDF&G. The quality of length-frequency data may be improved by instituting a

formal sampling plan that takes into account the species landed, month of landing, and optimum sample size. (D. Holts, 619-546-7186 and A. Coan, 619-546-7079)

1992 California Gillnet Observer Data Compiled and Edited

Fishery Biologist Alan Jackson of the Multispecies Data Collection and Evaluation Program reports that data collected during 1992 by the California Gillnet Observer Program have been compiled, edited, and made available to researchers and managers.

Since 1990 the NMFS, under the authority of the Marine Mammal Protection Act and with the cooperation of the California Department of Fish and Game, has placed biological technicians (observers) aboard fishing vessels to collect information on marine species associated with the California gillnet fisheries. The types of information collected include incidental mortality of marine mammals and other protected species, fishing effort, and catch.

In 1992, NMFS observers were aboard 852 fishing trips made by 136 vessels for a total of 2,974 net pulls. Observers counted a total of 92 cetaceans, 481 pinnipeds, 334 birds, and 5 turtles killed in the gillnets. The most frequently caught finfishes (in numbers of fish) were white croaker (8,655), Pacific mackerel (7,377), California halibut (6,608), bat ray (5,944), and California skate (3,538). Observers recorded length measurements for 4,811 California halibut, 797 blue shark, 677 spiny lobster, 348 barred sand bass, and 233 Pacific sardine. (A. Jackson, 619-546-7048)

Volume Completed on "Fisheries of Hawaii and US-Associated Pacific Islands"

The rapidly changing fisheries of the US Pacific islands are well known in Hawaii and the central Pacific, but the availability of information has been generally limited to Council annual reports, agency administrative reports, and data reports-- nowhere is there a published source of reference information dealing with fisheries in this region available to scientists and the public. Lab Director George Boehlert organized a meeting of interested parties (and potential authors) in late 1991 at the Honolulu Laboratory to develop a volume of papers to address this shortcoming; participants agreed that papers summarizing the fisheries sector with up-to-date information otherwise available only in unpublished form would be quite useful. The scope of the volume of papers is limited to domestic island-based, rather than distant-water, fisheries, thereby excluding tuna purse seine and albacore fisheries and island-based foreign fleets in the case of Guam and American Samoa. Each paper includes information on the biology of the species involved, a synopsis of the fishery (including historical trends, gear and vessel types, data sources and collection, status of stocks, and a brief description of markets), current research and research needs, issues associated with management and regulation of the fishery, and future prospects. This volume was published as a special issue of Marine Fisheries Review [55(2)], with Boehlert serving as editor of the issue. (G. Boehlert, 808-943-1211)

SPAR 5 and South Pacific Tuna Treaty Meeting Held

The fifth meeting of the South Pacific Albacore Research (SPAR) Group was held in Papeete, French Polynesia, during March 29-April 2. The staff of the Southwest Fisheries Science Center (SWFSC) submitted three working documents for the meeting: (1) "Summary of the 1990-91 US South Pacific albacore fisheries data" by G. Rensink, (2) "Report of SWFSC research activities for South Pacific albacore during 1991-92 and plans for 1993" by SWFSC staff, and (3) "Reproductive patterns of South Pacific albacore, *Thunnus alalunga*, as indicated by gonosomatic index and meiotic activity" by SWFSC Fishery Biologist Darlene Ramon and Kevin Bailey, previously with the South Pacific Commission. These documents along with others submitted by scientists from American Samoa, Australia, Cook Islands, Fiji, French Polynesia, Japan, New Caledonia, New Zealand, Solomon Islands, Taiwan, Tonga, and the South

Pacific Commission formed the basis for an evaluation of fisheries results and condition of the stock by the Group.

Fisheries statistics reviewed at the meeting indicated that in 1992, the surface fishery caught an estimated 7,300 t of albacore from the South Pacific. This catch was well below the peak taken in 1989 (31,000 t) and the lowest catch for this fishery since 1987. Statistics for the 1992 longline fishery were not available; however, statistics for 1991, which indicated a total catch of 21,700 t, and anecdotal information on the 1992 fishery indicated that the 1992 catch was either the same as in 1991 or lower.

The Group reviewed the performance of the fisheries, trends in catch rates, and biological information to determine the condition of the stock. It concluded that since the moratorium on driftnet fishing went into effect in 1990-91, catches of South Pacific albacore have remained near or below their historical average. There is no evidence from the available stock abundance indicators that current levels of fishing are adversely affecting the stock. However, because the time series of abundance indicators is short and provides imprecise information on trends for recent years, the Group advised that rapid expansion in the catch not be encouraged at this time. (G. Sakagawa, 619-546-7177)

Results of Angler Survey Reported in 1993 Billfish Newsletter

The "1993 Billfish Newsletter" will be distributed in June 1993. The newsletter is an annual publication produced by the Southwest Fisheries Science Center as a service to the USA. angling community. Its emphasis is on billfish-angling results in the Pacific and Indian Oceans. The data used are from the 1991 Pacific Billfish Angler Survey which follows the trends in fishing in terms of catch rates for the recreational fishery. A summary of the information in the newsletter is as follows:

In 1991, the total number of billfish fishing days in the Pacific and Indian Oceans reported by those anglers responding to the Survey was 8,185, approximately one-half of the effort reported in 1990. Anglers responding to the Survey reported catching 4,694 billfish in the Pacific. The catch rate for the Pacific was 0.57 billfish/day or 1.7 days/billfish. This is about a 35 percent increase in catch rate from 1990, indicating better overall fishing.

In Southern California, anglers reported 2,107 days of fishing, about one-third less than in the previous year. The catch rate for striped marlin, measured as numbers of fish per day, was 0.06, which is about one-half the rate experienced in 1990. Other areas, including Baja California (striped marlin) and Acapulco, Mexico (sailfish), also reported lower catch rates.

In contrast, many areas reported significantly higher catch rates, including Hawaii (blue marlin), Tahiti (blue marlin), New Zealand (striped marlin), and Costa Rica (sailfish).

The 1992 Angler Survey will be included with the mailing of this year's "Billfish Newsletter." (N. Bartoo, 619-546-7073)

Blue Marlin Workshop Presentation

Fishery Biologists Robert A. Skillman and Christofer H. Boggs and industry Samuel G. Pooley participated in a blue marlin workshop, April 20-22, 1993, sponsored by the Western Pacific Regional Fishery Management Council (WPRFMC). These Honolulu Laboratory participants reviewed available fishery statistics and assessments which were presented to the workshop by Skillman. Case studies from other regions were presented by Robert Kearney of the Fishery Research Institute, Australia; Oscar Sosa-Nishizaki of CICESE, Mexico; and Steve Berkeley of Oregon State University, formerly of the South Atlantic Fishery Management Council. The views of the charter boat industry, recreational fishermen, and

the longline fishery were presented by members of the Hawaii fishery community, followed by a structured discussion to identify problems and to recommend courses of action to the WPRFMC.

The Honolulu Laboratory overview provided information on catch and catch rates of blue marlin fisheries in the Pacific and attempts at stock assessment. Pacific-wide catches reached an all-time high in 1990, the most recent year for which catch statistics are available. The increase is due to the expansion of Korean and Taiwanese longline fisheries since 1985. Stock assessments are out of date because of the unavailability of catch-per-unit effort (CPUE) data from foreign longline fisheries. One production model stock assessment, based on CPUE data through 1980, suggested that blue marlin were overexploited. More recent CPUE data through 1985 indicated little relationship between fishing effort and catch, preventing a meaningful production model assessment.

Hawaii fisheries account for less than 4 percent of the Pacific-wide harvest of blue marlin. Domestic longline landings decreased during the 1960s as foreign longline landings in the Hawaii area increased. However, the first major increase in Hawaii landings occurred in the late 1970s due to the expansion of domestic commercial troll fishing. A second major increase in landings occurred with the revitalization of the domestic longline fishery in the late 1980s, and Hawaii catches have been relatively stable since 1989. Despite these increases, commercial troll CPUE has not shown a downward trend in recent decades. The major decline in CPUE corresponds with that seen Pacific-wide in the 1950s and 1960s. Total Hawaii catch has increased in rough proportion to estimated equivalent Hawaii fishing effort. Total equivalent Hawaii effort was estimated as catch divided by troll CPUE. Troll fishermen at the meeting commented that catch rates have been maintained by improvements in fishing technology and voiced their strong opinion that local blue marlin abundance has actually declined. (R. Skillman, 808-943-1257; Chris Boggs, 808-943-1222)

Third Meeting of the WPYRG Held in Pohnpei, Federated States of Micronesia

In 1990, the Western Pacific Yellowfin Tuna Research Group (WPYRG) was formed in response to growing concerns over the expanding fisheries and catch of yellowfin tuna in the western Pacific. The Group consists of scientists and fishery officers who are interested in collaborative research on western Pacific yellowfin tuna for management advice. They are principally from South Pacific island nations, distant-water fishing nations, the South Pacific Commission (SPC), and the Forum Fisheries Agency (FFA).

The strategic plan for the Group includes achieving three objectives by 1994 through collaborative research among participants. The objectives can be stated in three questions: (1) What is the safe level of yield and exploitation for the stock? (2) What is the level of interaction among the different fisheries? and (3) What factors contribute to local depletion?

The Group held its third meeting in Pohnpei, Federated States of Micronesia, from June 21 through 23, 1993, under the chairmanship of Gary Sakagawa of the Southwest Fisheries Science Center (SWFSC). Scientists and fishery officers from 16 Pacific countries as well as from the Food and Agriculture Organization, the FFA, and the SPC participated. SWFSC Statistician Al Coan and Fishery Biologist Pierre Kleiber also attended and contributed to the deliberations.

At the meeting, the participants reviewed the latest information on the yellowfin tuna fisheries of the western Pacific. The information indicated that the total catch continues to increase, 310,000 metric tons (t) for 1991, and a possible record of 349,000 t (estimated) for 1992. For 1993, preliminary information indicated poor fishing for many of the fleets during the first semester. If this continues for the remainder of the year, the Group concluded that the total catch for the year will be less than for 1992.

The Group also reviewed advances in development of a common data base, biological information, and investigations into stock abundance. The highlights of the reviews were that current catches are not excessive and the yellowfin tuna stock is capable of safely withstanding further fishing pressure. Catch-per-unit effort indices for monitoring trends in stock biomass were also determined to be unreliable and appropriately used only to monitor fishery performance.

The third meeting concluded with a list of tasks and research initiatives to be completed or begun during the coming year in preparation for the fourth meeting. 1994 will mark the end of the term of the strategic plan; consequently, the fourth meeting will be largely devoted to highlighting achievements in meeting the objectives of the plan and discussing the future of the Group. (G. Sakagawa, 619-546-7177)

1993 Albacore Forecast Issued

The 1993 *Albacore Forecast* was issued by the Pacific Fisheries Resources Division in early June 1993. The Forecast was based on fisheries and oceanographic data through mid-May. The following is an overview:

The overall outlook for the 1993 United States North Pacific albacore fishery is for moderate-to good production, with potential landings exceeding the past several years. Residual warm water along the US west coast and related oceanographic conditions make it probable that albacore availability will be highest in waters north of San Francisco; however, availability from south of San Francisco to southern California should be greater than experienced last year. Albacore are expected to arrive in large numbers near the coast in mid-July, with earliest arrivals in the south and later arrivals further north. Relatively strong nearshore upwelling and associated frontal structures are evident from southern California to Cape Blanco. Continued northerly winds in June and July will help maintain nearshore upwelling. Sportfishing for albacore should be relatively good along the coast wherever the fish are held by local fronts. Off southern California, frontal development should produce generally favorable conditions outside the Southern California Bight. Due to warmer than normal waters off Baja California, extending into the Bight, there is a greater-than-average probability, but not as great as last year, for yellowfin and skipjack tunas and other warm-water fish to be available in the Bight and along northern Baja California within reach of San Diego-based boats. Warm-water exotics will not likely extend north of Pt. Conception. (N. Bartoo, 619-546-7073)

Shark Abundance Cruise Conducted

The Pacific Fisheries Resources Division (PFRD) and the California Department of Fish and Game (CDF&G) conducted an experiment in May to develop and evaluate a catch-per-unit effort index for pelagic sharks in the waters off southern California. Commercial landings for shortfin mako, *Isurus oxyrinchus;* common thresher, *Alopias vulpinus,* and blue sharks, *Prionace glauca,* have decreased substantially from highs in the mid-to-late 1980s. This, along with lack of information on age structure and other biological parameters, prompted the initiation of the experiment.

There is no consistent time series of catch-and-effort data that can be used to determine relative abundance of sharks off southern California. Changing management goals and an increasing number of regulations governing the shark fisheries of California have resulted in wide swings in catches, the distribution of fishing effort, and gear deployment. An experimental longline fishery for shortfin mako and blue sharks operated off southern California from 1988 to 1991. This longline fishery was regulated and conducted under standard procedures until suspended in 1991. Catch-and-effort data collected for this fishery appear to be the best time series available for monitoring mako shark abundance. However, the suspension of the fishery has left a data gap for recent years. The PFRD experiment was to determine if the gap can be bridged.

The experiment was built around standard longline procedures used by the pre-1991 fishery. The objective was to use commercially available longline gear to sample shark abundance in the waters off southern California. The NOAA ship *David Starr Jordan* was used as the fishing platform. Division staff members participating in the cruise included Computer Programmer Donna DaRodda; Fishery Biologists Dave Holts, Pierre Kleiber, and Darlene Ramon; and Biological Technicians John Childers, Randy Rasmussen, and Gary Rensink. CDF&G biologists were Meladie Palmer-Zeahlen, Leanne Laughlan, and Don Armstrong.

Length of the longline was limited to 2 miles per set, with 100 to 200 hooks each, in the area formerly used by the longline fishery. Fishing for sharks was conducted during the day and sets at night targeted swordfish and sharks. Each set was fished for 3 hours. Underwater observations indicated the gear was fishing at depths between 70 and 90 feet.

Fishing effort totaled 1,974 hooks in 16 fishing sets. In 12 day sets, 1,508 hooks yielded 170 blue, 20 common thresher, 2 shortfin mako sharks, and 8 pelagic rays. An additional 466 hooks in 4 night sets yielded 76 blue sharks but no swordfish. The catch rate of 0.13 mako sharks was consistent with May rates for the pre-1991 fishing season. The catch rate of 1.33 thresher sharks per 100 hooks was unexpected and may indicate some resurgence in local abundance of this species.

All healthy sharks when caught were tagged and released alive. In all, 5 common thresher, 1 shortfin mako, and 147 blue sharks were tagged and released.

Heart and blood samples were collected from 38 additional sharks by Chin Lai of Scripps Institution of Oceanography. During these dissections, it was determined that several of the sharks (20 percent) had died from bleeding caused when the fishing hook was swallowed and subsequently pulled forward, penetrating the heart muscle proper.

A repeat of the experiment is being planned for September 1993 aboard the CDF&G research vessel *Mako*. (D. Holts, 619-546-7186)

Albacore Drift Gillnet Interaction Project Continues

During May, NMFS Biological Technicians were trained and equipped for the North Pacific albacore troll fishery. Biological Technicians Eric Forney, Chris Fanning, and John Childers departed from Honolulu, Hawaii, aboard US albacore troll vessels during the first week of June, and Gary Rensink departed from Newport, Oregon, during the third week of June. This is the fourth year for these observations, which are intended to quantify the interaction between US albacore troll vessels and the high-seas drift gillnets and to collect biological data on albacore. The objective of the observations is to observe the daily catch of albacore for evidence of injuries caused by encounters with high-seas drift gillnets and to collect size-of-catch and other biological data. This is the first season after the 1992 United Nations moratorium on high-seas drift gillnet fishing in the North Pacific, so fresh gillnet marks on albacore are anticipated to be nil and far below the high of 12 percent observed in 1990.

Preliminary reports from the observers indicate good-to-moderate fishing within the North Pacific transition zone. Incidence of albacore with gillnet mark injuries is negligible in the offshore areas. (D. Holts, 619-546-7186)

Longline Fishing in the Western Pacific

Staff from the Fishery Monitoring & Economics Program and the Pelagic Resources Investigation prepared 140 charts of Hawaii longline fishing effort and catch rates for the Western Pacific Regional Fishery

Management Council (Council). The charts record number of vessels, number of sets, number of hooks set, and catch rates for bigeye tuna (*Thunnus obesus*), blue marlin (*Makaira mazara*), swordfish (*Xiphias gladius*), and yellowfin tuna (*Thunnus albacares*) during 1991 and 1992 in one-degree square increments. Three seasonal increments were also charted, as were increments for small, medium, and large vessels. The charts will be used by the Council to examine changes in area closures or alternative permit schemes for vessels operating inside and outside the Hawaii Exclusive Economic Zone.

Using confidentiality criteria to protect unique fishing locations, 95% of total sets were charted in 1991 but only 73% in 1992. The lower rate of plotting in 1992 occurred because of the diffusion of the longline fleet that year. As a result, only fishing within latitude 10-35°N, longitude 140-180°W was charted. However the actual extent of the fishery in 1992 was latitude 0-45°N, longitude 175°E-140°W.

Charts were prepared to indicate the range (non-confidential) of the fishery in 1991 and 1992 by plotting the number of vessels fishing in one-degree squares. Plotted values are scaler values from 0 to 5 representing the cumulative unweighted distribution of actual values. The scaler 1 represents the lowest 20% of each plotted variable's values, the scaler 2 represents the 20-40% range of values, and so forth, with the scaler 5 representing the 20% largest values. The range for each scaler is given in the legend at the bottom of the chart. The value 0 in cost-per-unit effort (CPUE) charts represents no catch of a particular species. The charts were prepared by Frederick Dowdell, computer specialist, Sam Pooley, leader, Fishery Monitoring & Economics Program, Gerard DiNardo, fishery biologist, and William Kwok, computer specialist, Pelagic Resources Investigation. (S. Pooley, 808-943-1216)

Tuna Movement Model Developed

Movement is a natural phenomenon of great importance in the lives of many fish species, but this phenomenon has been largely neglected in stock assessment models. Tuna are no exception. Much of Pelagic Ecosystem Model Development Program Leader Pierre Kleiber's research is devoted to making tuna movement models for the twofold purpose of measuring parameters of movement by fitting the models to data and incorporating movement information into tuna stock assessments.

One of the problems Kleiber has encountered in developing movement models of tuna is the high rate of movement in relation to the temporal and spatial scales that he is dealing with. To implement such models on a computer, it is necessary to divide time and space into discrete increments. In a recently developed model having two spatial dimensions, the time was divided into 1-month increments, with the spatial cells measuring approx-imately 50 km on each side. The population turnover in such cells can typically be several hundred percent per time step. To generate a solution, one needs to predict a population in one time increment t based on the population at the current time t. That is,

$$P^{t+\Delta t} = P^{t} + f(P^{t})$$

where the model is embodied in function *f* of the population at some time during the interval. With explicit forward time stepping, is assumed to be the start of the time interval, that is, *t*. With this scheme the high turnover is bound to produce unstable solutions, that is, the predicted population will undergo wild swings at each time step and the model will probably crash. Alternative means of modeling the turnover per time step are being explored. (P. Kleiber, 619-546-7076)

Observers Return from 1993 Albacore Troll Season with Catch and Gillnet Injury Data

The Pelagic Fisheries Resources Division (PFRD) has, for the last four seasons, placed biological technicians on US albacore troll vessels to obtain catch and length-frequency data and to examine the

catch for injuries (or marks) indicating previous encounters with foreign high-seas driftnets. Samples were taken from within the traditional US albacore troll fishing grounds in the northeastern Pacific.

Biological Technicians Eric Forney, Chris Fanning, and John Childers departed from Honolulu aboard US albacore troll vessels during the first week of June 1993 while Gary Rensink departed from Newport, Oregon, during the third week of June. They all returned by the second week of September. Their objectives included measuring and examining as many of the albacore landed each fishing day as was possible.

Fishing on the vessels was generally poor to fair, with a few very good days, throughout the North Pacific Transition Zone and coastal areas. Highest numbers were taken west of 140° W longitude. A total of 10,738 albacore were examined for net marks and measured for both fork length and maximum girth during the 275 fishing days observed this season. The 1993 length-frequency distribution indicates the presence of 2-, 3-, and 4-year old albacore, more typical of the 1990 and 1991 data than the 1992. The strong 3-year-old age class of 1992 may have been influenced by El Nino conditions.

Of the catch observed, only 0.31 percent showed signs of previous interaction with driftnets, down from 3.1 percent last year and a high of 12.4 percent in 1990. This is the first fishing season after the 1992 United Nations ban on all high seas drift gillnet fishing in the North Pacific. While this low incidence of marked fish is encouraging, it is too early to speculate that the ban is responsible since effort data from the high seas driftnet vessels is not yet available.

The technicians also collected 300 albacore heads during their cruises to use for studies of age. One otolith, the opercal plate (gill cover), two vertebrae, the first dorsal fin spine, and an anal fin ray from each fish were collected and sent to Margarit Margolles at Centro de Investigation Cientifica de Educacion Superior de Ensenada (CICESE) in Ensenada, Mexico, for ageing studies while the second otolith from each fish was sent to Fishery Biologist Keith Bigelow at the Honolulu Laboratory for confirmation analysis. (D. Holts, 619-546-7186)

Second Shark Abundance and Tagging Cruise Completed With California Department of Fish and Game

The Pelagic Fisheries Resources Division and the California Department of Fish and Game (CDF&G) conducted their second experiment to develop and evaluate a catch-per-unit effort (CPUE) index for pelagic sharks in the waters off southern California. Fishery Biologists Darlene Ramon and Dave Holts participated in the September cruise aboard the CDF&G research vessel *Mako*. Ten sets were conducted, using stainless steel longline gear. Total effort was 1,102 hooks deployed, which varied between 80 and 173 per set depending on sea state, water temperature, and time of day. CPUE (catch per 100 hooks) was 3.1 shortfin mako shark, 4.2 blue shark, 1.0 pelagic ray, and 0.0 thresher shark. CPUE on the first cruise conducted in the same area in May aboard the NOAA ship *David Starr Jordan* was 0.1, 12.5, 0.4, and 1.0, respectively.

A total of 34 shortfin mako sharks (10 male, 12 female, 12 unknown) and 46 blue sharks (45 male, 1 female) were tagged and released during the cruise. (D. Holts and D. Ramon, 619-546-7074)

Thirteenth North Pacific Albacore Workshop Scheduled

Another in a series of biannual albacore workshops is to be held at the Southwest Fisheries Science Center in December 1993 with albacore scientists from Japan, Korea, Taiwan, Canada, and the United States. In preparation for this workshop, Stock Assessment and Fishery Impact Analysis Program Leader Norman Bartoo and Pelagic Ecosystem Model Development Program Leader Pierre Kleiber have been conducting

generalized additive model (GAM) analyses of the catch-and-effort data from the US North Pacific troll fleet The data span the years 1961 to the present.

GAM analyses were used to explore the statistical effects of independent variables on a dependent variable, where the effects can be expressed via non-linear transformations of the variables. The only constraint on the transformations is that they are determined by a smoothing process. The scientists searched for the optimum transformation for each independent variable.

The dependent variable selected for the analyses is the log of the catch-per-unit effort (CPUE) in spatio-temporal strata (1- or 2-degree squares and monthly time intervals) with 0.1 added to account for instances of zero catch. Various independent variables are being evaluated, the main one being time, to generate a time series of CPUE with the effects of various other independent variables removed. Additional independent variables so far include latitude, distance from the North American west coast, and Southern Oscillation Index (SOII), which is related to El Nino events. The latter is here dubbed an index of an index because it is the melding of two time series, neither of which covers the whole span of years of the fishery data. One is the Southern Oscillation Index for the years 1970 to present and the other is an earlier series approximating to be the Southern Oscillation Index. Where the two series overlap (years 1950 to 1985), they are similar, but not coincident. As a temporary measure, while waiting to obtain a more reliable El Nino index for the required time span, Kleiber and Bartoo merged the two series to conduct a preliminary GAM analysis. The two series were scaled to be as close as possible to each other in the overlapping years, and the average of the two were taken during those years.

Preliminary results indicate that latitude appears to have the strongest effect, which is confirmed by the chi-square measures of contributions of the various effects on the dependent variable. All effects are statistically significant ($P < .01$), but the magnitude of the SOII effect is substantially less than the others. The declining trend of CPUE with time is not a good sign if CPUE, with effects of variables other than time removed,is interpreted as an index of abundance. Such an interpretation is not warranted at this time because results are preliminary. A better index of El Nino, covering the years of the fishery data is needed to replace the SOII, and additional independent variates (such as upwelling index, need to be explored. Such changes could modify the trend in the effect of time seen here. (N. Bartoo, 619-546-7073; P. Kleiber, 619-546-7076)

Workshop Held on Marine Turtle Hooking Mortality

A Workshop on Marine Turtle Hooking Mortality, sponsored by the Honolulu Laboratory and NMFS Headquarters, was held November 16-18, 1993 in Honolulu. Turtle experts from across the United States, Australia, and Japan participated in this workshop, which was designed to develop a coordinated research plan for estimating the mortality and physiological impact on marine turtles hooked or entangled in longline fishing gear. The first day of the workshop was dedicated to technical presentations on longline fishing, the Endangered Species Act, and turtle physiology and fishery interactions. The second day was a facilitated strategic planning session in which specific research objectives and activities were identified. On the third day, a number of related issues including mitigation and observer protocol were discussed, and detailed research outlines were prepared. The results of the workshop will be presented to NMFS Headquarters by January 1, 1994. Zoologist George Balazs of the Honolulu Laboratory's Protected Species Investigation (PSI) was the workshop host and convener, and Industry Economist Sam Pooley of the Fishery Monitoring and Economics Program (FMEP) was workshop facilitator. Research Associate Shawn Koga and Biological Technician Bryan Winton of PSI and Computer Specialist Frederick Dowdell and Biological Science Technician Russell Ito of FMEP provided technical assistance.

Those attending the workshop included Alan Bolten and Elliott Jacobson, University of Florida, Gainesville; Scott Eckert and Pamela Yochem, Hubbs-Sea World Research Institute, San Diego,

California; Kiyoshi Katsuyama, Japan Fishing Agency, Tokyo, Japan; Itaru Uchida, Port of Nagoya Public Aquarium, Minatoku Hagoya City, Japan; Jeffrey Miller, Department of Environment and Heritage, Queensland, Australia; Bernard Thoulag, Micronesian Maritime Authority, Pohnpei, Micronesia; Charles Caillouet, NMFS, Galveston, Texas; Phil Williams, NMFS, Silver Spring, Maryland; Larry Ogren, Southeast Fisheries Science Center (retired); Frederick White, Scripps Institution of Oceanography (retired); and Christofer Boggs and Jerry Wetherall of the Honolulu Laboratory. (G. Balazs, 808-943-1240; S. Pooley, 808-943-1216)

Pilot Observer Program Guidelines Developed for Hawaii Longline Fishery

Gerard DiNardo of the Joint Institute for Marine and Atmospheric Research (JIMAR) recently completed the report "Statistical Guidelines for a Pilot Observer Program to Estimate Turtle Takes in the Hawaii Longline Fishery." The intent of the report was to provide statistical guidelines for the development of an observer sampling program for the Hawaii longline fishery. The development and implementation of the sampling program is a requirement of a recent internal Biological Opinion rendered under a Section 7 Consultation conducted by the NMFS in response to concerns regarding the incidental taking of listed sea turtles by this fishery.

The sampling design was developed using 1991 and 1992 Hawaii longline logbook and 1990-92 observer data. The distribution of reported fishing trips by trip type (target species) and associated number of sets fished in the 1991 and 1992 fishing seasons were presented. For all months, tuna fishing trips were generally proximal to the Hawaiian Islands with mixed trips north of the tuna effort and swordfish effort north of the mixed effort. Significant numbers of vessels exclusively targeted swordfish, tuna, or some mix of both. For example, during the 1991 fishing season 28 percent of the longline vessels fished exclusively for tuna, 11 percent fished exclusively for swordfish, and 24 percent always fished for a mixed catch. The remaining vessels (37 percent) switched between targets from trip to trip with no obvious pattern. During the 1992 fishing season, 30 percent of the longline vessels fished exclusively for tuna, 19 percent fished exclusively for swordfish, 31 percent always fished for a mixed catch, and 20 percent switched between targets. The identification of exclusive groups of vessels within the longline fishery is basic to developing strata and sampling frames.

A total of 11 trips (109 sets) were monitored by scientific observers in the longline fishery between 1990 and 1992. Because a full-fledged observer program had not been established at the time, cooperating vessels were opportunistically sampled. All vessels monitored fished exclusively for swordfish. A total of 7 turtle interactions were observed on 3 of the 11 monitored trips.

Because information from the Hawaii longline logbook system has not been verified, the logbook data were considered to be suspect. The reported take of protected species was most likely downwardly biased because of nonreporting. Because the available observer data set was small (11 trips) and limited to vessels fishing exclusively for swordfish, the data were not considered to be representative of turtle interactions in the Hawaii longline fishery.

Consequently, additional baseline turtle interactions data will be required. To collect such data, a stratified pilot sampling design was proposed. Data from the logbooks were used to identify appropriate strata and sampling frames while observer data were used to estimate sample size requirements.

As sources of variability in turtle take rates were poorly known, stratification was based on characteristics of the fishery. While this approach is not efficient, it did represent the best approach until additional data are collected. Two stratification variables were proposed for the pilot survey: time and vessel trip type. In the survey design, all potential vessel trips were classified into a unique stratum defined by time and trip type. To facilitate sampling, vessel trips within trip type*time strata were defined as the primary

sampling units (PSU). A list of PSU belonging to each stratum represents the sampling frame and provides the basis for the selection and identification of the units in the sample. Longline sets within a given vessel trip were defined as the secondary sampling units from which turtle take data will be collected.

For the pilot program an array of sample size choices was presented to cover a range of tolerance levels and confidence levels for estimation of total turtle take assuming both normal and negative binomial take rate distributions. An example of sample size choices, assuming a negative binomial take rate distribution, was presented. It was assumed that approximately 10 longline sets comprise a trip. A sampling frame for the pilot survey was developed and appropriate sample selection procedures advanced. Procedures for optimizing future sampling were also described. (G. DiNardo 808-943-1259)

Social Science Investigators Meet

Social science investigators from the University of Hawaii's Pelagic Fisheries Research Program (PFRP) met at the Honolulu Laboratory on November 5, 1993 to discuss issues of project coordination. Thirteen people, including PFRP manager John Sibert, attended the meeting. Suggestions were made for sharing data acquisition, but no specific conclusions were reached. Investigators were encouraged to attend the May 1994 tuna conference in California, although most social science investigators are located in Honolulu.

Fishery Management and Performance Investigation Chief Sam Pooley calculated revised estimates of 1992 commercial landings for Hawaii. Combining State of Hawaii commercial catch reports with NMFS logbook and shoreside monitoring information, total commercial landings in 1992 were 30.4 million pounds ($62 million). Longline landings accounted for 21.2 million pounds ($44.6 million) of this total; the small-scale troll-handline pelagics fishery was the second largest fishery (4.4 million pounds, $7.2 million). Landings in 1991 were approximately 29 million pounds ($61 million). The 1992 information will be included in next year's Fisheries of the United States. (S. Pooley, 808-943-1216)

United Nations Moratorium Report Completed

Fishery Management and Performance Investigation Chief Sam Pooley, industry economist, reported that Daniel D. Huppert and Todd Mittleman of the University of Washington completed their report "Economic Effects of the United Nations Moratorium on High Seas Driftnet Fishing" (September 1993). The report was the result of a research grant supported by the NMFS Southwest Fisheries Science Center and is being issued as a NOAA Technical Memorandum.

This report concentrates on the likely disposition of the Asian driftnet fleet following the imposition of the moratorium in 1992. Tabular data presented indicates the likely disposition based on field work in Japan, South Korea and Taiwan in late 1992. The basic alternative dispositions were scrapping and shifting into alternative fisheries. The authors found that government compensation programs were important in scrapping vessels, with a much higher percentage of vessels being scrapped in Japan because of a well-financed compensation program. Restrictions and opportunities in alternative fisheries also differed among the countries, as did the relative costs and capabilities of the vessels.

Huppert and Mittleman found that the overall economic impact of the high-seas driftnet moratorium on the three countries was not easily summarized nor were the potential impacts on other countries through conversion into other fisheries or through reductions in landings of squid and albacore. However, the authors estimated that 8,000 of the 16,000 people employed by the driftnet fishing industry lost their jobs because of the moratorium and that the total value of lost seafood landings is $414 million. The purpose of the driftnet moratorium was to support the populations of high-seas marine mammals, birds, and turtles

Huppert is associate professor of economics at the University of Washington's School of Marine Affairs. Mittleman was a graduate student and associate investigator on the project.

1993 NMFS Publications and Reports

Publications

Bigelow, Keith A., and Kevin C. Landgraf.
1993. Hatch dates and growth of *Ommastrephes bartramii* paralarvae from Hawaiian waters as determined from statolith analysis. *In* Okutani, T., R. K. O'Dor, and T. Kubodera (eds.), Recent advances in cephalopod fisheries biology, p. 15-24. Tokai University Press, Tokyo.

Planktonic young (paralarvae) of *Ommastrephes bartramii* have recently been found in early spring (March-May) along the Hawaiian Archipelago. Statoliths of paralarvae (N = 57) sampled in February 1991 were used to estimate ages, hatch dates, and growth rates. Growth increments within statoliths were enumerated using light and scanning electron microscopy. Under the assumption that increments were formed daily, paralarvae were estimated to grow exponentially for at least 35 days post-hatching. Based on the growth model, paralarvae 15, 25, and 35 days old had estimated mantle lengths of 1.6, 4.3, and 12.1 mm, respectively. The paralarvae were estimated to have hatched between 1 and 25 January 1991, based on back calculation of statolith increments from the time of capture.

Boehlert, George W. (ed.)
1993. Fisheries of Hawaii and U.S.-associated Pacific Islands. Mar. Fish. Rev. (special edition) 55(2).

A compilation of papers dealing with fisheries in Hawaii and U.S.-associated Pacific islands. The topics include pelagic fisheries, economics, fisheries data, and interactions with protected species.

Boggs, Christofer H.
1992. Depth, capture time, and hooked longevity of longline-caught pelagic fish: timing bites of fish with chips. Fish. Bull., U.S. 90:642-658.

To resolve the uncertainty in estimating capture depths of fish on pelagic longline gear, electronic microchip hook timers were attached to branch lines to record when bites occurred, and time-depth recorders (TDRs) were attached to longline gear, off Hawaii in January 1989 and January-February 1990. Hook timers indicated that 32% of the striped marlin Tetrapturus audax, 21% of the spearfish *T. angustirostris*, and 12% of the bigeye tuna *Thunnus obesus* were caught on sinking or rising hooks, demonstrating that capture time data are needed to correctly estimate capture depth. Recorded and predicted longline depths differed greatly, indicating that TDRs are essential for describing depth distributions of fish from longline catches. Most (>60%) of the spearfish and striped marlin were caught on settled hooks (not sinking or rising) at depths of <120 m, whereas most bigeye tuna were caught at depths of >200 m. This suggests that eliminating shallow hooks could substantially reduce the bycatch of spearfish, striped marlin, and other recreationally important billfish without reducing fishing efficiency for bigeye tuna. Bigeye tuna and striped marlin survived up to 6-9 hours after capture, and over 50% of 12 frequently caught taxa were alive when retrieved, suggesting that the release of live fish can be an effective management option.

DiNardo, Gerard T.
1993. Statistical guidelines for a pilot observer program to estimate turtle takes in the Hawaii longline fishery. NOAA-TM-NMFS-SWFSC-190, 40 p.

Jones, David R., Richard W. Brill, and Peter G. Bushnell.

1993. Ventricular and arterial dynamics of anaesthetised and swimming tuna. J. Exp. Biol. 182:97-112.

Cardiovascular dynamics of tuna have been investigated by recording blood pressures and flows in the central circulation of both anaesthetised and swimming individuals. In anaesthetised fish (N=5), heart rate averaged 112±21 beats min^{-1} (mean±S.E.) and stroke volume was 0.67±0.24 ml kg^{-1} when normoxic water flowed over the gills. Ventricular diastolic pressure was zero until atrial contraction filled the ventricle. Ventral aortic pressures were high (mean 12.08±1.15kPa), and blood flow was continuous in the ventral aorta throughout diastole. Dorsal aortic pressure (mean 6.3±1.28kPa; N=4) and flow were both pulsatile. Pressure polsatility (pulse pressure as a proportion of mean pressure) was about one-quarter of flow pulsatility, indicating considerable compliance in the dorsal aortic circulation. Total peripheral resistance averaged 0.17±0.4 kPa ml^{-1} kg^{-1} min^{-1} of which gill resistance averaged 48±15% (N=4). For the ventral aorta, impedance modulus fell markedly from the mean value and then declined more gradually towards zero with increasing harmonic frequencies. Impedance phase was negative (-0.8 to -1.1 rad) meaning that flow leads pressure at all harmonics. In swimming yellowfin tuna (N=5), heart rate averaged 108.8±12.1 beats min^{-1} and mean ventral and dorsal aortic pressures were 11.6±0.5 and 6.8±1.2kPa, respectively, so gill resistance was 42% of total peripheral resistance. Average stroke volume in three swimming kawakawa was 0.54±0.2 ml kg^{-1} at a mean heart rate of 128±48 beats min^{-1}. Data from swimming fish were within the range obtained from anaesthetised tuna. A simple model of the fish circulation consisting of two sets of compliant and resistive elements coupled in series (a second-order RC network) gave reasonable predictions of arterial pressure-flow relationships. Hence, we conclude that a "Windkessel" dominates central cardiovascular dynamics of tuna despite heart rates and blood pressures that fall in the mammalian range.

Seki, Michael P.

1993. Trophic relationships of *Ommastrephes bartramii* during winter migrations to subtropical waters north of the Hawaiian Islands. *In* Okutani, T., R. K. O'Dor, and T. Kubodera (eds.), Recent advances in cephalopod fisheries biology, p. 523-529. Tokai University Press, Tokyo.

Ommastrephes bartramii occupy waters in the North Pacific near the Subarctic Boundary during summer and fall where they are targeted by international driftnet fishing fleets. During the winter, *O. bartramii* migrate south to spawn in subtropical waters probably between 25° and 35°N latitude. Diet and trophic relationships were examined for *O. bartramii* during the winter occupation of these subtropical waters. Food composition was determined for stomachs from 42 large (48-57 cm mantle length), mature female *O. bartramii* captured by large (180 mm) mesh driftnet (*ōme ami*) during 12-19 February 1991. The bulk of the diet was composed of cephalopods (60.5%) and micronektonic fishes (37.7%); cannibalism was common. The relationship between winter-migrating *O. bartramii* and the recently developed swordfish, *Xiphias gladius*, longline fishery is also discussed. Squids found among swordfish stomach contents included adult *O. bartramii*, *Thysanoteuthis rhombus*, and *Sthenoteuthis oualaniensis*.

Skillman, Robert A., and George H. Balazs.

1992. Leatherback turtle captured by ingestion of squid bait on swordfish longline. Fish. Bull., U.S. 90:807-808.

Watson, C. L., H. A. Morrow, and R. W. Brill.

1992. Proteolysis of skeletal muscle in yellowfin tuna (*Thunnus albacares*): evidence of calpain activation. Comp. Biochem. Physiol. 103(B):881-887.

1. White muscle of yellowfin tuna is subject to a form of deterioration known as "burnt tuna."
2. TEM and SDS-PAGE were used to quantify cellular differences in deteriorated white muscle of yellowfin tuna.
3. Electron micrographs showed a significant loss of Z-disc integrity and an increase in intracellular edema in burnt tuna.
4. Electrophoresis established that a specific doublet of proteins, 42 kD and 46 kD was lost.

5. Proteolysis of isolated myofibrils incubated in calpain (EC 3.4.22.17) was greatest at pH 7.5 and was selective for intermediate molecular weight proteins.

6. This evidence suggests that burnt tuna is a specific and limited proteolysis of myofibrillar structural proteins characteristic of calpain proteolysis.

Approved by Science and Research Director

Benetti, Daniel D., Richard W. Brill, and Syd A. Kraul.
1993. The standard metabolism, heart rate and red muscle distribution of dolphin, *Coryphaena hippurus*. Fish. Bull.

Dewar, Heidi, Jeffrey B. Graham, and Richard W. Brill.
1993. Studies of tropical tuna swimming performance in a large water tunnel II: thermoregulation. J. Exp. Biol.

Huppert, Daniel D., and Todd W. Mittleman.
1993. Economic effects of the United Nations moratorium on high seas driftnet fishing. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SWFSC-000, 61 p.

Ito, Russell Y., Donald R. Hawn, and Bruce B. Collette.
1993. First record of the butterfly kingfish *Gasterochisma melampus* (Scrombridae) from the North Pacific Ocean. Fish. Bull.

Polovina, Jeffrey J., and Boulderson B. Lau.
1993. Temporal and spatial distribution of catches of tiger sharks (*Galeocerdo cuvier*) in the pelagic longline fishery around the Hawaiian Islands. Mar. Fish. Rev.

Pooley, Samuel G.
1993. Managing longline fishing in Hawaii--practical aspects of regulatory economics. Mar. Res. Econ.

Townsend, Ralph E., and Samuel G. Pooley.
1992. Application of fractional licensing in the Hawaii longline fleet. N. Am. J. Fish. Manage.

Uchiyama, James H., Robert A. Skillman, and Jeffrey D. Sampaga.
1993. Age, growth rates, and hatch dates of larval dolphins (*Coryphaenidae*) from Hawaiian waters. Fish. Bull., U.S.

Administrative Reports

Brill, Richard W., and David R. Jones.
1992. The influence of hematocrit, temperature, and shear rate on the viscosity of blood from a high energy demand teleost, the yellowfin tuna, *Thunnus albacares*. J. Exp. Biol.

Dollar, Robert A.

1993. Annual report of the 1992 western Pacific longline fishery. Honolulu Lab., Southwest Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396. Southwest Fish. Sci. Cent. Admin. Rep. H-93-12, 25 p.

Translation

Nakano, Hideki, Makoto Makihara, and Kenji Shimazaki.
1985. Distribution and biological characteristics of the blue shark in the central North Pacific. Research Institute of North Pacific Fisheries, Faculty of Fisheries, Hokkaido University, Special Volume, No. 170. (Engl. transl. by W. G. Van Campen, 1993, 20 p., Transl. No. 149; available Honolulu Lab., Southwest Fish. Sci. Cent., Natl. Mar Fish. Serv., NOAA, 2570 Dole St., Honolulu, HI 96822-2396.)

Pacific Fisheries Research Program

Following are status reports, as of July 1994, on Year-1 projects funded by the PFRP. The project is sponsored by the Council, NMFS and University of Hawaii, and is managed at the University.

1. Local pelagic catch and effort data analysis and integrated modeling to quantify the effects of local fisheries on fish availability. PI: Dr. Christofer Boggs. PI and staff are sorting out data from various sources, classifying trip types, and developing local interaction models. Funding was received at the University in August 1993.

2. Design of tag-recapture experiments for estimating yellowfin tuna stock dynamics, movement and fishery interactions. PI: Dr. Jerry Wetherall. Little progress has been made to date on this project due to the excessive workload of PI. A promising candidate for the modeller position was identified in January, but no staffing action was take. After consultation among collaborators, John Sibert was invited to assume the role of "lead PI" on this project. With Wetherall, Kleiber and Boggs participating as collaborators, this arrangement will facilitate more rapid progress and insure that project activities are consistent with Sibert's integrative modeling work. Staffing action was reactivated in June to recruit the modeller who will be located in Honolulu. Funding was received at the University in August 1993.

3. Analysis of Pacific blue marlin and swordfish population structure using mitochondrial and nuclear DNA technologies. PIs: Dr. Barbara Block and Dr. John Graves. PIs are analyzing the population structure of these two species. Both presented scientific reports at the Lake Arrowhead Tuna Conference in May 1994. Funding was received at the University in August 1993.

4. Automated monitoring of yellowfin tuna at Hawaiian FADs and the relationship to water mass dynamics based upon satellite imagery. PI: Dr. Peter Klimley. Klimley has obtained authorization from the State of Hawaii to attach monitoring devices to FADs. All necessary equipment is on hand and Klimley has made one trip to Honolulu to attach monitors and familiarize himself with local conditions. Fishing for yellowfin was poor in the first half of 1994

and he was unable to deploy transmitters on fish. He plans on shipping a small research boat to Honolulu, and has developed collaborative plans with Dr. Pierre Flament to attach monitors to Flament's Langrangian drifters. Funding was received at the University in August 1993.

5. Reproductive biology of yellowfin tuna, *Thunnus albacares*, in Hawaiian waters and the western tropical Pacific Ocean. PIs: Dr. Gordon Grau, Mr. Richard Shomura, Mr. David Itano. PIs have made progress in organizing sampling by fisheries observers throughout the central western Pacific and by local collaborators in Hawaii. Analysis of the preserved gonads samples will begin soon. Funding was received at the University in December 1993.

6. Physical characteristics of the environment influencing pelagic fishes. PI: Dr. Pierre Flament. Preliminary arrangements for deployment of drifters and for development of oceanographic circulation models are complete. Deployment of drifters is expected to begin in September 1994. The modeling component of this project has been revised. A separate physical modeling proposal will has been submitted and is under review. Funding was received at the University in August, 1993.

7. Hawaii fishing vessel economics. PI: Dr. Samuel Pooley. PI and staff are currently collecting economic data from the longline fleet. Funding was received at the University in August 1993.

8. Social aspects of the Hawaiian pelagic troll fishery. PI: Dr. Marc Miller. PI has made two trips to Honolulu and plans another one this summer for background necessary to develop survey methodology. Funding was received at the University in August 1993.

9. Structure and dynamics of the U.S. tuna marked for fresh Pacific tuna and marlin. PIs: Dr. John Kaneko and Mr. Paul Bartram. Funding for this project was received in April 1994 and work was expected to begin in July.

10. Contributions of tuna fishing and transshipment operation to local economics. PI: Dr. Michael Hamnett. Field data collection has begin and some preliminary results are in hand. Funding was received at the University in September 1993.

11. Development of assessment model for western Pacific yellowfin. PIs: Dr. John Sibert and Dr. Pierre Kleiber. A small workshop was convened in November 1993 to design model specification for an age-structured spatially disaggregated population model for application to existing data on yellowfin catch at length. The workshop group recommended extension of the SPC's SPARCLE albacore model to include spatial structure and movement dynamics. Further work will be conducted in October 1994, to test the feasibility of implementing the SPARCLE code on a high performance UNIX workstation. Funding was received at the University in August 1993.

12. Integrative modeling in support of the Pelagic Fisheries Research Program: Spatially disaggregated dynamics models for pelagic fisheries. PI. Dr. John Sibert. Computing equipment has been ordered, staffing action for the programmer position has been completed, and preliminary efforts to implement spatially-variable diffusion are encouraging. Accelerated model development work is expected to begin in when the programmer begins his duties in August. Funding for this project was received in April 1994.